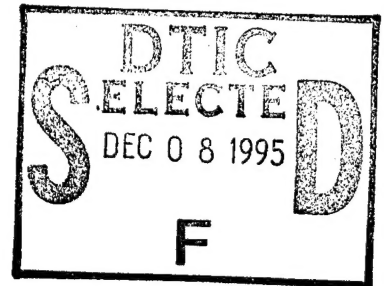
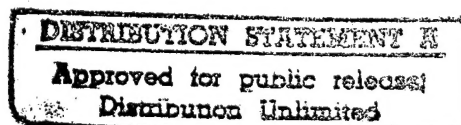

Marine Corps Modeling and Simulation Investment Strategy



Marine Corps Modeling and Simulation
Management Office



April 1995

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12 MAY 95

From: Commandant of the Marine Corps

Subj: MARINE CORPS MODELING AND SIMULATION INVESTMENT
STRATEGY (MCMSIS)

1. The Marine Corps Modeling and Simulation Investment Strategy (MCMSIS) is approved.
2. The MCMSIS translates the eight Modeling and Simulation (M&S) end-states addressed in the Marine Corps M&S Master Plan (MCMSMP) into prioritized funding for implementing advanced M&S, including distributed simulation, throughout the Marine Corps. The MCMSIS, along with the MCMSMP and the Marine Corps M&S Campaign Plan, provides the foundation for the development of the Marine Corps M&S related input to the Program Objective Memorandum as well as the basis for reassessment and reprogramming in the future.
3. The MCMSIS was designed to inform all organizations, active and reserve, of the direction in which the Corps is going with regard to M&S. Read it thoroughly, review it frequently, and incorporate its contents into your plans. I envision the Marine Corps moving towards capitalizing on the vast opportunities presented by M&S to improve the combat readiness of the Total Force.
4. My point of contact is Major Dean E. Fish, DSN 278-2498 or Coml (703) 784-2498.

A handwritten signature in cursive script, reading "C E Wilhelm".

C. E. WILHELM

By direction

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Executive Summary

The Marine Corps Modeling and Simulation Investment Strategy (MCMSIS) is a Total Force Strategy for attaining the Marine Corps' desired modeling and simulation (M&S) end states through Fiscal Year (FY) 2010. It provides program managers (PM) and other decision makers involved with the Combat Development Process (CDP) and the Planning, Programming, and Budgeting System (PPBS) with a strategy for implementing advanced modeling and simulation, to include distributed simulation, throughout the Marine Corps and across all functional areas. Although the first iteration of the MCMSIS concentrates on the M&S components directly related to operational readiness and the implementing actions calling for M&S as outlined in the Marine Corps Master Plan, subsequent iterations will be expanded to cover the full spectrum of M&S activities within the Marine Corps. Additional aspects of the PPBS, Combat Development and Acquisition processes will be addressed in the follow-up Marine Corps M&S Campaign Plan for POM 98.

The Marine Corps has defined a set of milestones for attaining operational M&S capabilities through FY2010. Each identified milestone represents attainment of a significant M&S capability that supports attainment of the desired Marine Corps end states delineated in the Marine Corps Modeling and Simulation Master Plan. The timeline associated with attainment of these milestones is based upon a logical progression in operational capabilities resulting from the expected availability of required enabling technologies. These milestones are presented in terms of five M&S operational capabilities which encompass the end states: (1) MAGTF training, (2) mission planning, (3) mission preview, (4) mission rehearsal, and (5) the combat development and acquisition processes.

The Marine Corps will rely heavily on leveraging jointly sponsored and the other service efforts in meeting M&S requirements. M&S technology procurement during the FY95-FY97 time frame will be accomplished primarily through non-Marine Corps funding by agencies such as the Defense Modeling and Simulation Office and the Advanced Research Projects

Agency. M&S technology procurement during the FY98-FY10 time frame will be incorporated in the Marine Corps POM process and will also include non-Marine Corps funding. The emphasis during the first three years will be providing the Marine Corps with the capability to conduct a series of instrumented live exercise demonstrations, the development of an initial analytical M&S capability, and development of a mission planning system for the Marine ground community that will form the basis for developing a Total Force mission preview and rehearsal capability in the out years equivalent to that existing within the aviation community today. Most of the Marine Corps' efforts during the next six years will be directed toward supporting development of the joint simulation system through joint sponsorship of the program and toward developing Marine Corps unique objects and applications to support analytical requirements. The last seven years will be devoted to developing deployable simulators and a globally accessible synthetic environment.

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Section 1

Introduction

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Section 1.1

Purpose

The Marine Corps Modeling and Simulation Investment Strategy (MCMSIS) is an iterative document that provides an integrated plan for attaining the Marine Corps' desired modeling and simulation end state.

The Marine Corps Modeling and Simulation Investment Strategy (MCMSIS) is a Total Force Plan that serves as a guide for developing Marine Corps modeling and simulation (M&S) capabilities through Fiscal Year (FY) 2010. It defines enabling M&S capabilities and provides an integrated plan for attaining the eight end states delineated in the Marine Corps Modeling and Simulation Master Plan (M&S Master Plan). This is not a requirements document, but rather a strategy for implementing advanced modeling and simulation, to include distributed simulation, throughout the Marine Corps and across all functional areas. It provides a strategy for taking advantage of the opportunity for the use of M&S provided by technological advances that permit the internetting of various models and simulators with a common synthetic environment to create an interactive distributed simulation. It contains sufficient information to establish a framework wherein the different components required to attain the Marine Corps M&S end states can be developed or obtained. The MCMSIS is written to support program managers and other decision makers involved with the Combat Development Process (CDP) and the Planning, Programming, and Budgeting System (PPBS).

A discussion of programmatic and technical execution of the M&S capabilities are beyond the scope and intent of this document. The follow-up Marine Corps M&S Campaign Plan (M&S Campaign Plan) will include high level milestones, product visions, descriptions of generalized work packages, projected proponent, management, and executing agencies, performance driven notional exit criteria for research and development (R&D) efforts, and envisioned life cycle management criteria. In order to accomplish the preceding, the appropriate PPBS actions will be delineated in the Campaign Plan, to include descriptions of proposed POM Initiatives. The next step consists of identifying specific M&S needs in Non-

ACAT Program Definition Documents (NAPDD), Mission Need Statements (MNS) and Operational Requirements Documents (ORD).

The first iteration of this document concentrates on the M&S components directly related to operational training readiness and the implementing actions calling for M&S as outlined in the Marine Corps Master Plan. As additional M&S tools are identified for Marine Corps use, this document will be updated and expanded to cover the full spectrum of M&S activities within the Marine Corps. This will include additional areas such as analysis, logistics, manpower, and C4I.

This document is organized into three sections. Section 1 provides the methodology and assumptions used in developing the MCMSIS and describes in more detail the eight M&S end states identified in the M&S Master Plan. Section 2 provides milestones and a schedule for implementing various M&S capabilities across the Marine Corps. Section 3 identifies and prioritizes the M&S thrusts required to attain the milestones described in Section 2.

This document also includes three appendices. Appendices A and B provide a representative sample of M&S efforts that support Marine Corps requirements. Appendix A provides information on efforts that have Marine participation or sponsorship, while Appendix B deals with efforts external to the Marine Corps. Appendix C provides a set of tables that present a metric for determining the relevance of various M&S technologies to Marine Corps interests.

Section 1.2

Methodology

A well defined, five step process, that included input from M&S experts and a representative cross-section of functional users, was used to develop the Marine Corps Modeling and Simulation Investment Strategy.

The end states defined in the M&S Master Plan were analyzed word by word to decompose them into elements representing distinct operational capabilities. A set of technologies that were required to obtain each of these elements of operational capability were identified and further decomposed into key technology components. This process facilitated the identification of operational capabilities that support multiple end states as well as technology components that support multiple operational capabilities. The product of this step was a set of tables that mapped technology components into the operational capabilities that support attainment of the M&S end states. The set of tables contained in Appendix C was the end product of this step.

A list of many of the leading current and planned M&S efforts was identified and assessed in terms of their ability to contribute to attainment of the end states. This was determined by comparing the operational capabilities and enabling technologies each effort would provide to those identified in the tables constructed during the decomposition process. The information obtained from these first two steps was melded together to formulate the M&S fielding plan.

The M&S fielding plan integrated the various operational capabilities onto one timeline based upon their planned or projected availability date. The operational capabilities provided by each Marine Corps sponsored effort was laid out on a common timeline, followed by those provided by external M&S efforts. The end result was a single timeline showing when various operational capabilities required to support attainment of the various end states would be available. Based upon this timeline a set of milestones related to M&S operational capabilities and a schedule for their achievement was developed.

The resulting M&S milestones and schedule were used to perform a critical path analysis for each end state at the operational capabilities level. The results of the critical path analysis formed the basis for identifying operational capabilities thrusts over the period covered by the Investment Strategy. Each operational capability was evaluated in terms of the technologies required to support it. Each component of the identified technologies were then evaluated to determine their criticality to achieving the required operational capability. The results of this assessment, at both the operational capability and technology component levels were used to determine the M&S technology thrusts.

Finally, the M&S technology thrusts were prioritized. Several factors were considered in determining the prioritization. Paramount among them were: (1) obtaining the M&S milestone within the prescribed timeline; (2) the relative importance of various M&S functional capabilities as indicated by the weights contained in the tables in Appendix C; (3) the number of end states supported; and (4) capabilities that cannot be obtained through leveraging of other efforts.

M&S technology procurement during the FY95-FY97 time frame will be accomplished primarily through non-Marine Corps funding by agencies such as the Defense Modeling and Simulation Office and the Advanced Research Projects Agency. M&S technology procurement during the FY98-FY10 time frame will be incorporated in the Marine Corps POM process and will also include non-Marine Corps funding.

The MCMSIS is an iterative document requiring yearly updates to take advantage of rapidly evolving M&S enabling technologies, to account for M&S program schedule changes and emerging requirements, and to account for fluctuations in available resources resulting from budget decisions. Details of the "how to" will be addressed in the M&S Campaign Plan.

A working group comprised of representatives from major organizations within the Marine Corps Combat Development Command (MCCDC), Marine Corps Systems Command (MARCORSYSCOM), and Headquarters, Marine Corps (HQMC) that are primary users of M&S served as a steering committee for the development of this document. They made

significant contributions throughout this process, reviewing and approving the methodology as outlined above as well as the results of the various steps.

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Section 1.3

Assumptions

The Marine Corps Modeling and Simulation Investment Strategy is based on a set of assumptions that define the environment for the time frame of the Strategy.

This Strategy is based on the following assumptions:

- There will be constrained resources for national defense throughout the period of the strategy.
- Marine Corps force posture will consist of Continental United States (CONUS)-based forces, forward based forces, and forward deployed forces.
- The Marine Corps missions and roles will remain relatively the same as currently defined.
- The Services will continue to move toward a joint and combined forces oriented operational, training, and support environment.
- The Department of Defense (DOD) will continue to move toward the development of a joint simulation system in response to training and analytical requirements.
- The Marine Corps will not adopt institutionalized training (e.g., the use of large numbers of simulators located at a permanent site).
- Modeling and simulation capabilities will be uniform throughout the Marine Corps (e.g., M&S capabilities on the East Coast will mirror those on the West Coast).
- The Marine Corps will leverage other programs to the maximum extent possible.

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Section 1.4

Modeling and Simulation End States

The modeling and simulation capabilities envisioned by the Marine Corps are delineated by eight desired end states that are articulated in the Marine Corps Modeling and Simulation Master Plan.

The eight end states as articulated in the Marine Corps Modeling and Simulation Master Plan are provided in Table 1-1. Programmatic associated with attaining the end states and development of the MCMSIS require further specificity. This section provides details and clarification for each end state to the degree required for a common understanding. It identifies the M&S functional capabilities and technologies necessary for the attainment of each end state.

Table 1-1. List of Desired Marine Corps M&S End States

End State	End State Description
End State 1:	Exercise any size Total Force Marine Air-Ground Task Force (MAGTF) as part of a combined or joint force from home bases, aboard ship, or forward deployed through the seamless integration of live, virtual, and constructive simulations
End State 2:	Conduct mission planning in a distributed environment
End State 3:	Conduct mission preview and rehearsal on land or at sea at all levels, from the individual Marine to Marine Expeditionary Force (MEF), within 48 hours of tasking
End State 4:	Validate Marine Corps requirements and doctrine using M&S as a primary tool
End State 5:	Participate in the fundamental improvement of the acquisition process by simulating before "we buy, build, or fight"
End State 6:	Merge M&S and command, control, and communications (C3) systems
End State 7:	Support every major weapon system in the Marine Corps with a simulator that can be networked into a common synthetic environment
End State 8	Use M&S as a primary decision support tool

End State 1: Exercise any size Total Force MAGTF as part of a combined or joint force from home bases, aboard ship, or forward deployed through the seamless integration of live, virtual, and constructive simulations. A variety of models, simulations, and simulators at different geographic locations will be linked, and the activities of all trainees integrated, to represent different task organized units and training activities. Joint training exercises will be driven by a common joint simulation system that incorporates live, virtual, and constructive simulations into a common seamless synthetic environment. Computer generated friendly forces will fight on the synthetic battlefield along side actual units involved in instrumented exercises. The same simulation system will support Marine Corps specific training at all levels from the individual Marine to a MEF. Synthetic battlefields that replicate an actual operational environment will be used, and computer-generated adversaries, friendlies, and neutrals will be introduced into the synthetic battlefield for realistic training. Marine Reserve units will conduct realistic unit training and participate in MAGTF and Joint level training without leaving their reserve sites. Marines using deployable simulators and advanced telecommunications will conduct training at all operational levels while embarked aboard ship or forward deployed.

End State 2: Conduct mission planning in a distributed environment. Mission planning will be accomplished at all operational levels using 2-dimensional and 3-dimensional displays that support decision making. These systems will allow the commander and his staff to move through his area of responsibility (AOR) identifying key terrain features, control and coordination points, avenues of approach, objectives, and other operationally significant features. Friendly and threat lay downs, including system characteristics will be displayed to facilitate the formulation of courses of action (COA). Evaluation of COAs will be aided through the use of models and simulations that allow "what if" types of analysis. Based on the outcome of these simulations, commanders at all levels will be able to assess the supportability of various COAs as a function of force deployment plans, military strategies, logistical considerations, force mix and size, and training readiness. The goal is to eventually allow commanders to accomplish the rapid planning process within a 6 hour period.

End State 3: Conduct mission preview and rehearsal on land or at sea at all levels, from the individual Marine to MEF, within 48 hours of tasking. Commanders and their staffs

at all levels will be able to evaluate COAs and conduct mission rehearsals on a synthetic battlefield with different threat overlays. This capability will range from rehearsing for generic missions in an environment similar to that of the potential operating area, to rehearsing for specific missions where the potential adversaries, their tactics, weapon systems, and equipment are simulated in an environment that is known in great detail. Computer generated forces with realistic behaviors and detailed modeling of systems (sensors through weapon platforms) will provide life-like operational threats. The individual Marine as well as Marine tactical units of all sizes will be able to conduct realistic mission rehearsals against these hostile threats in a synthetic environment. The use of deployable simulators and advanced telecommunications will extend this capability to shipboard units. Eventually, commanders will be able to accomplish Total Force mission preview and rehearsals within 48 hours of tasking. This mission preview capability currently exists within Marine Aviation.

End State 4: Validate Marine Corps requirements and doctrine using M&S as a primary tool. The use of M&S will enhance the Marine Corps' effort in defining and validating requirements and doctrine by facilitating "what if" analysis. Participants can focus on a specific operational capability and determine the likely impact of implementing that action by gaming it with accredited models against a sample of threat scenarios. Participants can then repeatedly modify the modeled capability, wargame it, and promptly view the result until an optimal position is attained. The initial validation of requirements and doctrine will be conducted using constructive models or manned simulators within a synthetic environment, or a combination of the two. The final validation of requirements and doctrine may be supported using a combination of constructive models, manned simulators, and live exercises. Within a synthetic environment, virtual developmental prototypes or existing simulators will be modified to represent alternative systems or equipment items, and man-in-the-loop simulation conducted against different threats, using a standard set of scenarios. Initial system design considerations will be evaluated by program managers (PMs), combat developers, and Warfighters experimenting on a common synthetic environment. The outcomes of various engagements on the synthetic battlefield will be compared to identify differences in operational capability provided by the alternative systems. The same process

will be used to identify an optimum mix of weapons systems and equipment for specific missions, and to refine system designs throughout the acquisition process.

End State 5: Participate in the fundamental improvement of the acquisition process by simulating before "we buy, build, or fight." The costly "design-build-test" acquisition paradigm will be substantially replaced with a design process that uses virtual prototyping in a synthetic environment to investigate and evaluate the concept, exploration, development, design, testing, production, and sustainment of a system. Alternate solutions will be evaluated both from a tactical and technical perspective through simulation. Promising alternatives will be simulated through the use of reconfigurable simulators linked to computerized force-on-force combat models and virtual environments, giving the Warfighter the means to evaluate the performance and contribution of a new system in a realistic operational context.

As the system progresses through the acquisition cycle, the components (models, simulators, and simulations) will be refined and new components added (operational models, complementary weapons system models, and logistics models). PMs will refine their designs before incurring the cost of fabrication by exercising their virtual prototypes in synthetic environments to evaluate design alternatives and conduct trade-off analyses. As hardware is developed it will be integrated into the synthetic environment and used to evaluate performance and conduct confirmation tests to revalidate the system for development and production.

Once an alternative has been selected, development testing will be accomplished using the virtual prototype to refine the system design. Changes in the design necessitated as a result of development test and evaluation (DT&E) are applied quickly to the virtual developmental prototype and the process continued until the final design is verified, at which time the physical prototype is built. The virtual developmental prototype will also be used in the synthetic environment to supplement actual tests permitting evaluations using a broader range of scenarios, conditions, and sample size. Conditions not evaluated during the field test, such as weather and visibility, are evaluated by manned virtual developmental prototypes and included in the final operational assessment. The use of computer generated forces in the

synthetic environment will allow play against a broader range of threats and effectively extend the number of developmental systems simulated. Actual operational field tests will be planned and rehearsed using these virtual developmental prototypes and synthetic environments. These test rehearsals will be used to examine, evaluate, and identify any problems with the overall test design, measurement design, data collection process, instrumentation placement, and scenario. In this way, M&S will be used to predict, enhance, and extend the results of field tests, not replace them.

The synthetic environments, models, simulations, simulators, and scenarios that were continuously refined to support a system acquisition decision will be used to support the system once it is fielded, becoming a part of the Marine Corps' ADS environment that supports all the end states. PMs will use these synthetic environments to support product improvement programs (PIPs) and engineering change proposals (ECPs) for their systems. Through the use of models, simulations, and simulators on synthetic battlefields, PMs will model proposed system improvements or new technologies and assess the impact of these changes on overall system performance and combat effectiveness.

End State 6: Merge M&S and C3 systems. Distributed simulations will initially run over dedicated networks, such as DSI. Simulation outputs will be used to stimulate operational C3 and weapons systems. As technologies advance, portions of these distributed simulations will migrate from these dedicated simulation networks to those used by the Marine Corps operational C3 systems. Eventually, through the merging of simulation networks with operational C3 systems, it will become transparent to the participants whether they are involved in a simulation or real world operation.

End State 7: Support every major weapon system in the Marine Corps with a simulator that can be networked into a common synthetic environment. As part of the new acquisition paradigm, simulators will be developed in conjunction with major weapon systems. Simulators initially developed for concept exploration will be continually refined to evaluate alternative designs and define system specifications. These virtual simulators will be linked into the distributed environment permitting "warrior-in-the-loop" simulations to

support system development. These virtual simulators will evolve into training simulators that are fielded with the operational system.

End State 8: Use M&S as a primary decision support tool. Decision makers will be supported by a comprehensive set of M&S tools that include high resolution cost and systems engineering tools, appropriate level force-on-force combat models, standardized databases, and a common set of scenarios and terrain databases. M&S applications will provide the MAGTF commander with realistic estimates of his capability to support contingency and operations plans from the standpoint of such factors as arrival time, time required to build up effective combat power, and ability to sustain combat operations. New concepts, doctrine, tactics, procedures, and systems will be introduced onto the synthetic battlefield through user modification of models and simulations, and exercised against realistic computer generated threats. The outcomes will then be analyzed in detail before any changes are made to actual systems or doctrine.

M&S will provide the MAGTF staffs with tools to assess their capability to react to various contingencies. Using a set of approved models, planners will be able to simulate mobilization activities, develop and evaluate COAs, test schemes of maneuver, and evaluate aviation and combat service support plans.

Differences in operational capabilities between alternatives will be developed using high fidelity engineering models to derive performance characteristics that will feed the appropriate level force-on-force combat model. Within a synthetic environment multiple engagements will be conducted on a virtual battlefield using virtual prototypes and /or manned simulators to assess alternative systems. Differences in operational capabilities will be compared across the alternatives.

Logistics planners will have global access to a set of accredited M&S tools, databases, and scenarios, that will allow them to simulate the movement of forces from their home bases, stations and reserve locations into the operational theater. The movement of material from production and storage facilities to the end user in theater will be simulated in a similar manner. Planners will perform detailed analyses of the ability of available transportation

assets to support Commander-in-Chief (CINC) operational and contingency plans, and assigned Marine Corps roles and missions. Sea, air, and land transportation assets, including ports and air bases, will be modeled to assess throughput capability. M&S will allow logistics planners to match transportation assets to requirements and determine strategic and tactical movement feasibility in all modes of transportation (sea, air, rail, truck, barge, etc.). Detailed modeling of the six functional areas of combat service support (supply, transportation, health services, engineering, maintenance, services) and an integration of these with combat models will provide planners with current assessments of the MAGTF's logistics capability and readiness. This modeling capability coupled with automated planning tools will allow planners to provide the commander with more accurate assessments of supportability at any time during planning, execution and training.

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Section 2

M&S Milestones

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Section 2.1

Overview

The Marine Corps M&S milestones outline an integrated building block approach to attaining the eight desired end states.

The milestones for attaining operational M&S capabilities within the Marine Corps through FY10 are presented in chronological order in Table 2-1. Each milestone indicated represents attainment of an M&S capability that is significant to attaining the Marine Corps desired end states. The timeline denoted in Table 2-1 reflects a logical progression in M&S operational capabilities within the Marine Corps that are based upon the expected availability of requisite enabling technologies. In most cases, new or improved operational capabilities are developed by building upon previous capabilities. The mission planning capability is expanded to include new functionality and extended to provide new capabilities. For example, from FY96 to FY97, the 2-dimensional mission planning capability for ground operations is expanded to a 3-dimensional capability, and in FY98 an analytical capability is added to allow "what if" types of analysis. This capability is further expanded to provide for distributed mission planning within the Marine Corps and ultimately distributed mission planning within the joint arena. Additionally, the 3-dimensional mission planning capability is extended to provide mission preview, which in turn is extended with the introduction of dynamic interaction with the environment and threat into a mission rehearsal capability. This building block approach is maintained throughout the sixteen year period outlined in this strategy.

For ease of discussion in the subsequent subsections, the milestones were reorganized to support attainment of five M&S operational capabilities: (1) MAGTF training, (2) mission planning, (3) mission preview, (4) mission rehearsal, and (5) the combat development and acquisition processes. MAGTF training encompasses end state 1. End state 2 is addressed in mission planning. End state 3 is separated into its mission preview and mission rehearsal components and addressed separately under those two topics. End states 4, 5, 6, and 7 are addressed under combat development and acquisition processes, and portions of end state 8 are addressed under each of the five operational capabilities.

Table 2-1. Marine Corps M&S Milestones

M&S Milestone	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10
Conduct mission planning in 3-D (Air)	▼															
Conduct mission preview at sea/forward deployed (air platforms)	▼															
Exercise MAGTF Staff		▼														
Conduct live exercise with instrumented Marines and weapon platforms		▼														
Conduct 2-D mission planning (Ground)			▼													
Conduct 3-D mission planning (Ground)			▼													
Conduct training for squad leader to MEU staff in synthetic environment			▼													
Conduct mission rehearsal at home base (all air platforms)			▼													
Conduct "what if" analysis for mission planning				▼												
Conduct mission preview at home base (air platforms)				▼												
Exercise MAGTF Staff (Active component) as part of joint or combined force from home base					▼											
Conduct distributed mission planning (Internal to the Marine Corps)					▼											
Validate Marine Corps requirements and doctrine using constructive model					▼											
Validate system designs using virtual prototyping						▼										
Exercise MAGTF Staff as part of joint or combined force from home base						▼										
Conduct distributed mission planning for joint and combined operations							▼									
Conduct mission preview at home base (ground weapon platforms)								▼								
Conduct mission rehearsal at home base (ground weapon platforms)									▼							

Table 2-1. Marine Corps M&S Milestones (Continued)

M&S Milestone	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10
Exercise MAGTF as part of joint or combined force from home base with ground weapon platforms simulators integrated								▶								
Exercise MAGTF as part of joint or combined force from home base with live exercises integrated									▶							
Validate Marine Corps requirements and doctrine using reconfigurable simulators																
Conduct mission preview at home base (individual ground combatant)										▶						
Exercise MAGTF as part of joint or combined force from home base with individual ground combatant and small unit simulators integrated											▶					
Conduct mission preview from the Individual Marine to MEF in distributed environment at home base																
Conduct mission preview at sea/forward deployed (ground weapon platforms)																
Conduct mission rehearsal at home base (individual ground combatant)																
Conduct mission rehearsal from the individual Marine to MEF in distributed environment at home base																
Validate Marine Corps requirements and doctrine using advanced distributed simulations																
Conduct distributed mission planning for joint and combined operations within 24 hours of tasking																

Table 2-1. Marine Corps M&S Milestones (Concluded)

M&S Milestone	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10
Conduct mission preview at sea/forward deployed (individual ground combatant)												▼				
Conduct mission rehearsal at sea/forward deployed (ground weapon platforms)												▼				
Exercise MAGTF as part of joint or combined force home base												▼				
Conduct mission rehearsal at sea/forward deployed (individual ground combatant)													▼			
Conduct mission rehearsal at sea/forward deployed (air platforms)														▼		
Exercise MAGTF as part of joint or combined force aboard ship or forward deployed														▼		
Conduct mission preview from the individual Marine to MEF in distributed environment at sea/forward deployed															▼	
Conduct mission rehearsal from the individual Marine to MEF in distributed environment at sea/forward deployed															▼	
Conduct distributed MEF level mission rehearsal within 48 hours of tasking															▼	
Conduct simulations using tactical C4I systems																▼
Network all simulators into a common synthetic environment																▼

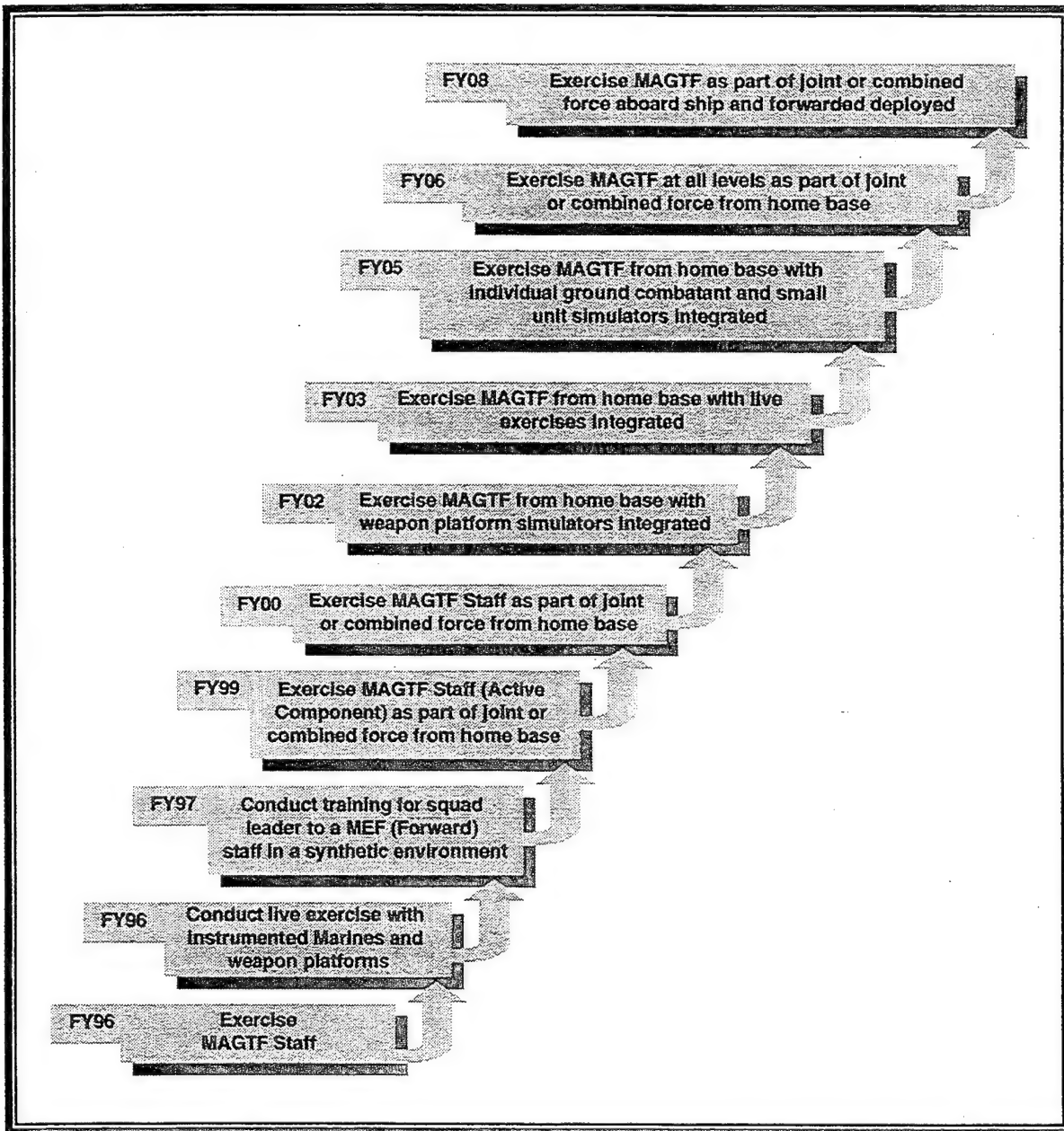
Section 2.2

MAGTF Training

The integration of constructive models, instrumented live exercises, and a variety of manned simulators into a distributed environment will provide the MAGTF with a global training capability.

The M&S MAGTF training milestones and schedule for implementing the various components are provided in Figure 2-1. The initial ability to exercise the MAGTF Staff indicated for FY96 consists of staff training conducted at fixed sites using a series of locally networked workstations that support command and control training. This capability will support the training of each element of the MAGTF and their associated staff sections. The outcome of various staff and command decisions will be determined through the use of a constructive model and graphically displayed to the players.

By the end of FY96 the Marine Corps will have conducted an instrumented live exercise demonstration at the Marine Corps Air-Ground Combat Center (MCAGCC), Twentynine Palms, California. This demonstration will include the instrumentation of individual Marines, ground weapon systems, and rotary wing aircraft that will permit tracking of these entities and provide trigger pull data such as events, kills, and hits. An integral part of this capability will be a processing facility that collects the exercise data and allows data manipulation to provide detailed after action reviews and playback of the exercise. The playback capability will, at a minimum, provide a 2-dimensional representation of the exercise terrain, display the location of instrumented entities, and provide graphical representation of exercise events. After the implementation of the Joint Tactical Combat Training system (JTCTS) in FY00 and the integration of a ground participants instrumentation system, a fully instrumented MAGTF will be able to participate in an instrumented Naval Expeditionary Force (NEF) exercise.



**Figure 2-1. M&S Milestones for Implementing MAGTF Training
Within a Distributed Environment**

The capability to conduct squad leader to MEF (Forward) staff training in a synthetic environment will exist at MCAGCC by the end of FY97. The Marine Corps will be able to conduct squad leader to platoon commander level training in a synthetic environment comprised of a high resolution 3-dimensional representation of Range 400. Extension of the synthetic environment to include the Delta Corridor will permit the inclusion of combined arms that will support staff training through the MEF (Forward) level. Exercises will be able to be played back for review in a 2-dimensional plan view and a 3-dimensional representation of the environment that includes computer representations of Marine and threat forces. By the end of FY98, a sufficient number of other terrain data bases will have been developed such that the Marine Corps will be able to exchange the Delta Corridor database for others and conduct similar type training on terrain representations of other areas. By FY99, this capability will be extended to training of east coast active forces and Reserve Forces with establishment of similar facilities at the II MEF Command and Control Facility (CCF) of the Littoral Warfare Training Complex (LWTC) at MCB, Camp Lejeune, North Carolina, and at selected Marine Forces Reserve (MARFORRES) sites.

The fielding of the initial operational capability (IOC) for a joint simulation system during FY99 will allow the Commander and battle staff of a MAGTF comprised of active Marine components to train in a joint or combined operational setting as the Joint Task Force (JTF) Commander or as the command element of the Marine Corps component of the JTF. These exercises will be conducted in a distributed environment that share a common view of the battlefield and permit the command element to participate from their home bases. Decision outcomes will be determined through constructive simulations that use computer generated friendly and threat forces and are displayed graphically. Exercise players will be provided with a graphical replay capability to analyze the resulting combat outcomes of their staff actions and decisions. By the end of FY00, the capability to participate in these exercises from home base will be extended to include the Marine Reserve Components within the MAGTF battle staff through connectivity provided by the Distributed Simulation Internet (DSI).

In subsequent years the Marine Corps will have the capability to routinely integrate virtual and live simulations into a common synthetic environment to conduct exercises. By the end

of FY02 the Marine Corps will be able to routinely link manned air and ground simulators at various locations into a common synthetic exercise environment. Manned ground simulators like the Combat Vehicle Appended Trainer (CVAT) and manned aviation simulators like the FA-18 Operational Flight Trainer and the AH-1W or CH-53E Aircrew Procedures Trainers will participate in these exercises with additional computer generated ground and air systems representing both friendly and threat forces. Their movement and outcomes of threat engagements will be displayed on a common synthetic battlefield along with those of the computer generated forces. This will occur while the individual participants remain at their respective home bases. During FY03, the Marine Corps through the use of instrumented ranges and exercise areas, individuals, and weapons platforms will be able to integrate live force on force exercises into the common synthetic environment. By FY05, the Marine Corps will have individual ground combatant simulators like the Team Target Engagement Simulator (TTES) fielded and networked into the common synthetic environment. Use of the DSI or similar backbone will allow Marine units on opposite coasts to train together while remaining at their respective home bases.

The fielding of a full operational capability (FOC) for a joint simulation system during FY03 will facilitate the Marine Corps' capability to fully exercise any size Total Force MAGTF as part of a combined or joint force from home bases through the seamless integration of live, virtual, and constructive simulations. The Marine Corps development and fielding of deployable simulators coupled with the use of satellites to link them into a common synthetic environment will permit exercising of the MAGTF in a similar manner while units are aboard ship or forward deployed by the close of FY06.

Section 2.3

Mission Planning

The capability to rapidly generate realistic 3-dimensional environments that a commander can move through coupled with the ability to use M&S to assess different courses of action will allow the Marine Corps to accomplish detailed mission planning anywhere in the world.

An operational mission planning capability presently exists for Marine/Navy aircrews. The Department of Navy (DON) Tactical Aircraft Mission Planning System (TAMPS) utilizes direct access to Marine/Navy C4I nodes and Defense Mapping Agency (DMA) databases to provide aircrew with detailed 3-D mapping, threat, weather, and target (including imagery) information. Specific aircraft and weapon performance data is also provided by this system for both aircrew mission planning and actual data loads into aircraft weapon and avionics equipment. TAMPS is portable and supports 3-D aviation mission planning at home base, aboard ship, and while forward deployed.

An initial ground force mission planning capability is planned for FY96. This initial capability provides ground planners with a 2-dimensional view of the area of operations. It provides the planners with graphic representations indicating the location of friendly and threat forces, sensor data to include detection envelopes, and effectiveness envelopes of various threat weapons systems. It also provides for the graphic display of the scheme of maneuver (e.g., axis of advance and boundaries), fire support coordination measures (e.g., fire support coordination lines (FSCL) and no fire areas (NFAs)), logistics routes, and aviation corridors.

The availability of detailed terrain databases by the end of FY97 will facilitate movement of the ground mission planning capabilities into 3-dimensional representations. Planners will have the capability to move through a realistic 3-dimensional representation of the environment that can be rotated, zoomed and translated to any aspect. Detection, engagement and effectiveness envelopes of threat weapons systems will be displayed in 3-dimensional space, facilitating planning of threat avoidance routes. Once the mission planning is

completed, ground planners will have the capability to view the plan in 3-dimensions. During FY98 a threat analysis capability will be added that will allow commanders and planners to conduct "what if" type analysis using constructive models to assess the outcomes of different courses of action, choices of flight paths, support avenues, etc. Both the 2-dimensional and 3-dimensional ground mission planning system will be portable and support mission planning while aboard ship or forward deployed.

The Marine Corps' migration to a distributed interactive environment for mission planning during FY99 will permit all elements of the MAGTF, including Reserve components, to conduct mission planning on a common synthetic battlefield from their home bases. Commanders will have the capability to review any portion of the mission plan via a 3-dimensional visualization with the ability to rotate, zoom or translate it to any aspect. By FY01, the joint simulation system infrastructure should be developed to the degree that will provide connectivity and ready access to a common set of terrain, environmental and threat databases. The mission preview capability can then be extended to allow the MAGTF to conduct mission planning for joint and combined operations in a synthetic environment. Sufficient "black box" technologies that support the rapid construction of detailed synthetic environments will have migrated into the "white world" by FY06, providing the Marine Corps with the capability to conduct mission planning within 24 hours of tasking. The milestones and schedule for attaining mission planning capabilities within the Marine Corps are provided in Figure 2-2.

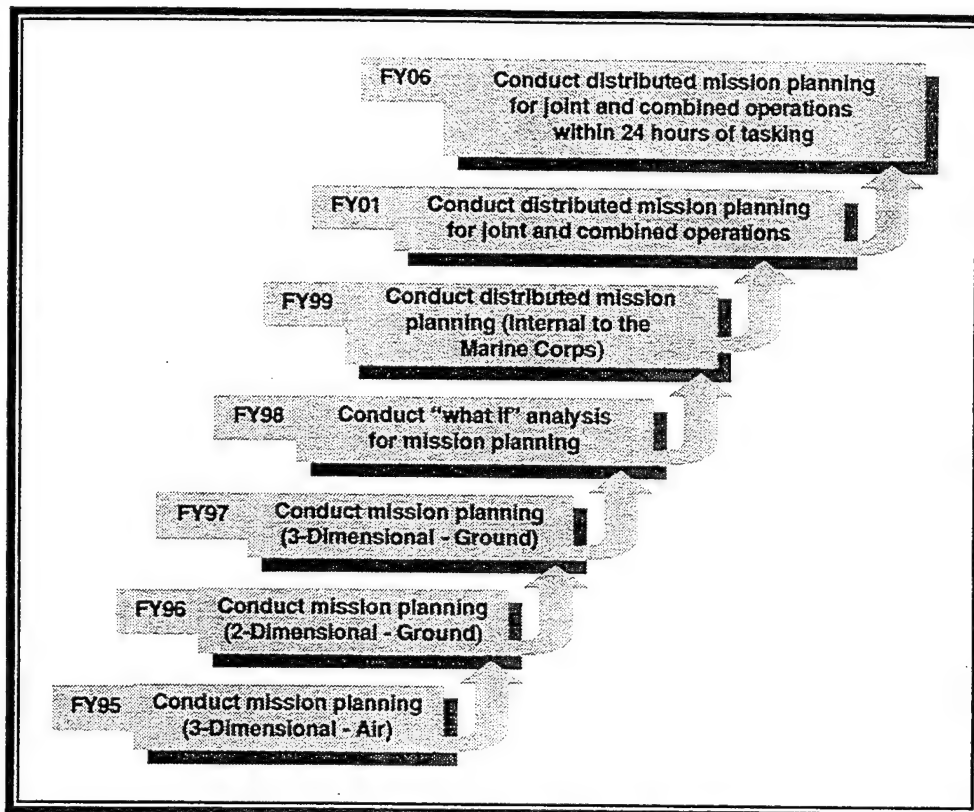


Figure 2-2. M&S Milestones for the Conduct of Distributed Mission Planning for Crisis Situations

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Section 2.4

Mission Preview

A distributed mission preview capability will enable planners, commanders, and individual combatants to move through a common synthetic battlefield and view relevant tactical data to validate and adjust their mission plan.

Figure 2-3 provides the milestones for mission preview capabilities within the Marine Corps. Through the use of a mission preview system, planners, commanders, and individual combatants will be able to run through their mission in a 3-dimensional synthetic environment that displays all relevant tactical data, including threats, friendly and enemy force locations, restricted and hostile airspace, detection and lethal envelopes for threat systems, weather/climate information, targets/objectives and interest areas. Aviators currently have a "cockpit perspective" for mission preview. This perspective is limited to viewing the environment on a high resolution graphics workstation where movement through the environment is controlled by generic flight controls. The current capabilities will be expanded to include more realistic computer generated threats, inclusion of environmental effects, and more detailed terrain representations as a result of more detailed and readily accessible threat, environmental and threat databases that are currently being developed.

By the end of FY02 the Marine Corps will have fielded the CVAT, a family of appended trainers (simulators) for the M1A1 tank, the LAV, and the Amphibious Assault Vehicles (AAV). The graphic capabilities of these appended trainers will provide the crews of these vehicles the capability to conduct mission previews. The introduction of simulators that support the individual ground combatant and small unit training into the Marine Corps coupled with the detailed terrain databases, environmental databases and computer generated forces at the individual combatant level will extend the mission preview capability to the individual and small unit level during FY04. Again, by leveraging the joint simulation system infrastructure (connectivity, common databases, detailed models, etc.) the

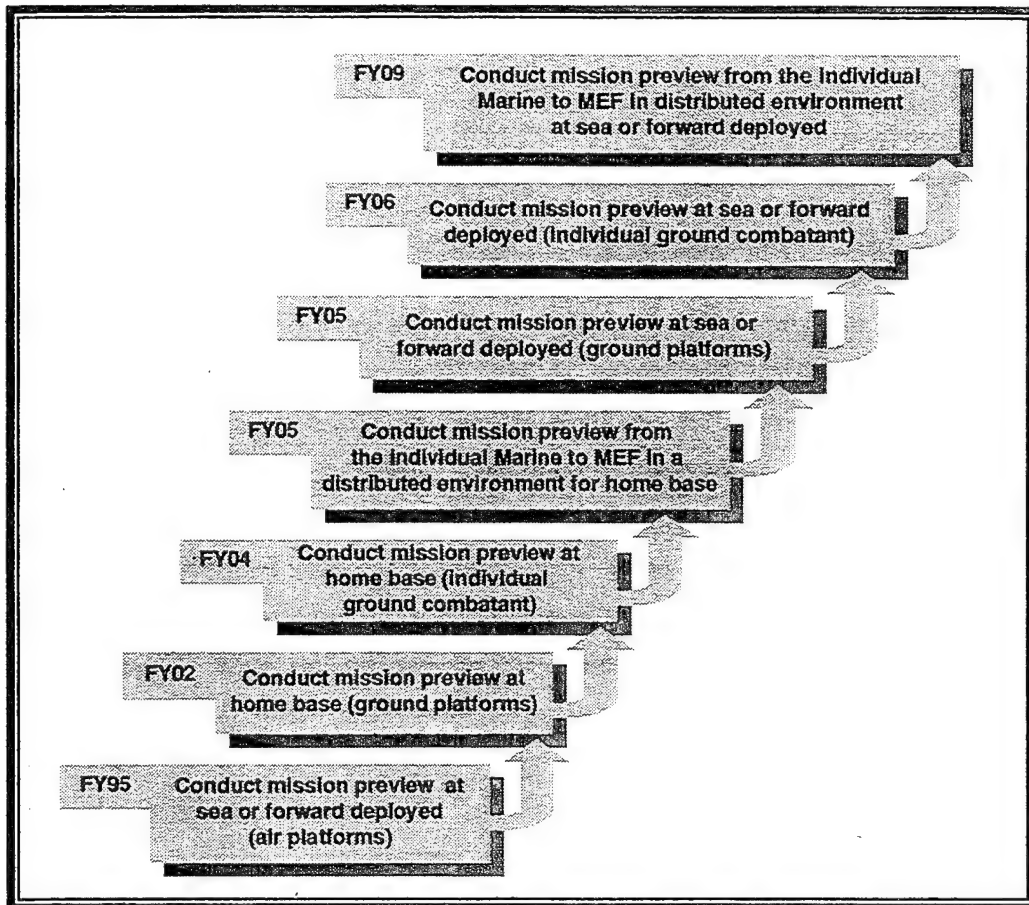


Figure 2-3. M&S Milestones for the Conduct of Distributed Mission Preview Throughout the Marine Corps

Marine Corps will be able to link their various simulators with those of the other Services to permit mission preview of combined operations on a common realistic synthetic battlefield, without moving individual participants from their home base.

By the end of FY09, through the use of deployable simulators and satellite communications, the Marine Corps will be able to accomplish the above with participants deployed anywhere in the world. The fielding of deployable simulators coupled with the capability to use the actual simulator for mission preview and the use of satellite communications will allow units

that are aboard ship and deployed anywhere in the world to conduct distributed mission planning. The milestones for accomplishing this for ground weapons, for the individual ground combatant, and for both fixed and rotary wing aircraft is based upon the expected fielding date of deployable simulators that support training for each of these four categories.

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Section 2.5

Mission Rehearsal

The capability to dynamically interact with realistic threats on a synthetic battlefield that replicates the operational battlefield will allow the Marine Corps to effectively conduct mission rehearsals anywhere in the world.

Mission rehearsal is the practice of planned tasks and functions critical to mission success using a true-to-life, interactive representation of the expected operating environment. Marine Aviation currently has this capability. Aircrews can fly in formation through a common synthetic environment, encounter and engage computer generated threats as if they were real, respond accordingly and review the results of not only the engagements but battle damage to specified targets as well. By FY97 the capability will be extended to allow the conduct of mission rehearsal at home base for all Type/Model/Series aircraft.

On the ground side, the capability to conduct mission rehearsal within a synthetic environment is the mission preview capability with dynamic threat and environmental interaction included. The milestones for mission rehearsal indicated in Figure 2-4 closely follow those for mission preview. In almost every case, it is a matter of introducing the ability to interact dynamically with the environment and realistic computer generated threats into the same synthetic environment that was created for mission preview. For example, current Defense Modeling and Simulation Office (DMSO) and Advanced Research Projects Agency (ARPA) sponsored efforts to develop dynamic environmental and threat interactions will enable the Marine Corps to integrate this capability into the synthetic environment used by ground simulators and provide an ability to rehearse actual missions similar to that which currently exists within selected aviation simulators.

By FY02, the dynamic interaction capability for both threats and the environment will be incorporated as part of the synthetic environment used by the Marine Corps ground weapon simulators providing ground weapon crews with the ability to conduct mission rehearsals. By the end of FY05, the synthetic environment for individual combatant simulators, which was

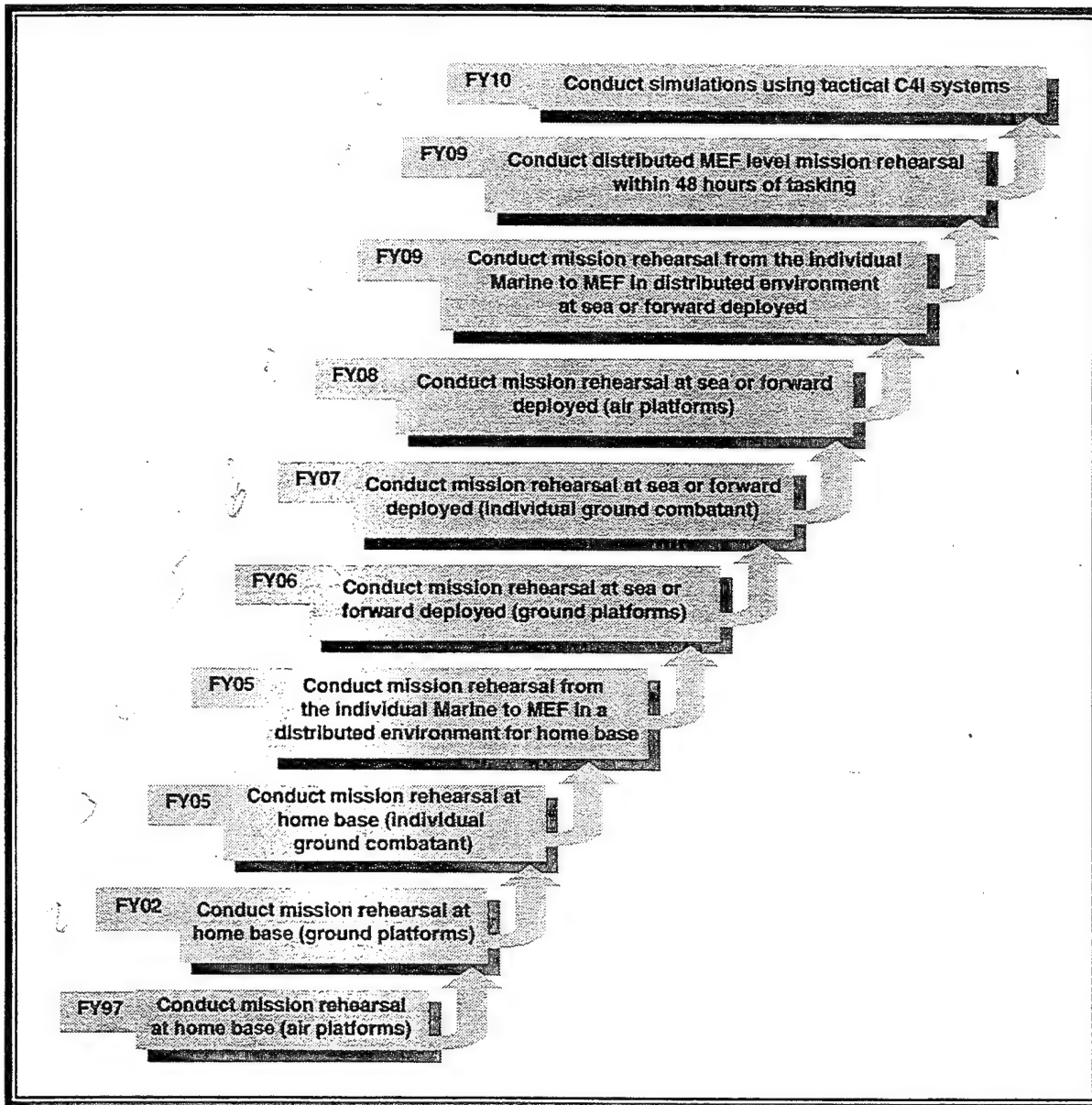


Figure 2-4. M&S Milestones for the Conduct of Distributed Mission Rehearsal Within a Common Synthetic Environment

used for mission preview, will be expanded to include similar dynamic interaction allowing mission rehearsal at the individual ground combatant level. Additionally, a MEF commander

will be able to rehearse operational missions in a synthetic environment comprised of networked aircraft, ground weapon systems, individual combatant and small unit simulators without having to physically move any of the participants from their home bases (including Reserve Forces). Marine tactical units will be able to move information through a common synthetic environment, encounter and engage a full spectrum of realistic computer generated threats, respond accordingly and see the outcomes. This capability will exist for every level from the individual combatant to the MEF.

From FY06 through FY09 the Marine Corps will build toward the ability for units that are aboard ship and forward deployed to rehearse operations in a common synthetic environment. This will be accomplished through the use of deployable simulators and satellite communications. The fielding of deployable simulators, the capability to use the actual simulator for mission rehearsal coupled with the ability to fully interact with a common synthetic environment, and the use of satellite communications will allow units that are aboard ship and deployed anywhere in the world to conduct distributed mission rehearsal. The milestones for accomplishing this for ground weapons, for the individual ground combatant, and for both fixed and rotary wing aircraft is based upon the expected operational capability to conduct mission preview using deployable simulators for each of these four categories. By FY09, the MEF commander will be able to rehearse operational missions from the individual combatant to the MEF level from any location within 48 hours of tasking. By FY10 the Marine Corps will fully effect the seamless integration of its tactical command, control, communications, computers and intelligence (C4I) systems with simulations to conduct mission rehearsals and training, thus negating the requirement for totally separate simulation networks.

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Section 2.6

Combat Development and Acquisition Processes

The integration of M&S as an integral part of the combat development and acquisition processes will result in improved efficiencies from the requirements identification phase to actual fielding.

Figure 2-5 provides the milestones for incorporating M&S as an integral part of the combat development and acquisition processes. By the end of FY99 the Marine Corps will be able to validate its concepts, requirements and doctrine using a set of constructive models. PMs and requirements developers will have ready access to a library of models ranging from detailed engineering and cost models to theater level force-on-force models. Doctrinal changes and emerging requirements will be evaluated using wargames, and appropriate level force-on-force models. Doctrinal changes will be effected through the modification of software code and examined for merit against a series of different modeled threats. In a similar manner, detailed level engineering models will be used to determine the performance characteristics of new systems or the merit of system improvements. The new systems or changes will run in force-on-force models to determine the resulting combat effectiveness of the system or change. Thus, Marine Corps doctrine and requirements will be validated against accredited models and algorithms.

By FY00, libraries of objects and associated behaviors for a myriad of system components will be readily available. PMs will be able to construct virtual prototypes by combining these objects with detailed engineering and environmental models. Using a graphical interface, PMs and engineers will be able to select different body styles, suspension systems, engines, weapons systems, transmissions, etc., to assemble a virtual prototype. They will then be able to deploy it in a variety of different synthetic operational environments to assess its performance against different threats, over different types of terrain and in different environmental conditions. Because hardware is not involved, multiple prototypes can be easily configured, allowing a wider range of system variations and performance factors to be evaluated and later facilitating validation of the final system specifications. Again, system

changes will be effected through code modifications and assessed using appropriate level force-on-force simulations to measure the effect on combat outcomes.

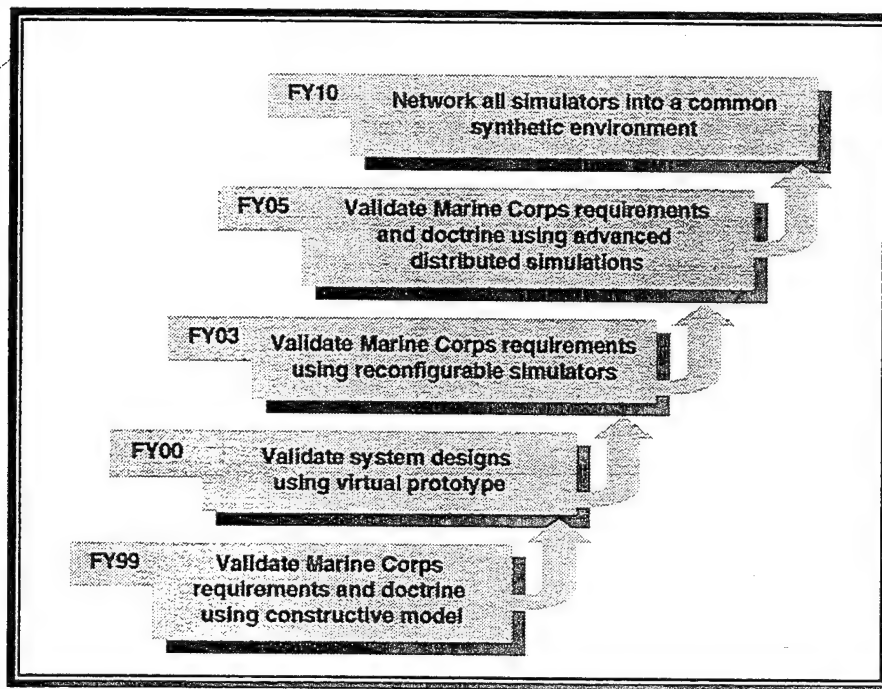


Figure 2-5. Key M&S Milestones Related to Improvement of the Combat Development and Acquisition Processes

Reconfigurable simulator technology is just emerging. By FY03, this technology will have advanced to the point that reconfigurable generic simulators can be used to construct and validate prototype systems. These simulators will be easily reconfigurable in both hardware and software. Through the use of these simulators, the Marine Corps will be able to integrate the Warfighter directly into the combat development and acquisition process to provide valuable feedback throughout the development process. Marines will be able to “fight” virtual mock-ups of systems they may someday be using in actual combat. Human factors

engineering and operational effectiveness of the systems will be evaluated through the exercise of these virtual prototypes.

By the end of FY05, the Marine Corps will be able to link virtual prototypes into a common synthetic battlefield. Marines will be able to test and assess virtual prototypes of systems within an operational setting against a variety of computer generated threats. Virtual prototypes will "fight" along side actual operational systems, and their ability to influence combat engagements against a wide variety of threats will be evaluated. PMs will be able to directly measure the contribution of proposed systems to combat effectiveness (and vice versa), as well as validate system specifications long before any physical prototypes are ever constructed. By FY10, the Marine Corps will be able to link any of its simulators, regardless of where they are physically located, into a common synthetic environment to assist in evaluating and validating new system requirements as well as for the conduct of training.

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Section 3

Modeling and Simulation Technology Thrusts

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Section 3.1

Overview

The Marine Corps has identified and prioritized M&S technology thrusts through Fiscal Year 2010 to maximize its return on M&S investments.

Table 3-1 provides an overview of the Marine Corps' plan for developing M&S capabilities through Fiscal Year 2010. It is based upon: (1) obtaining the M&S milestones provided in Section 2 within the prescribed timeline, (2) the relative importance of various M&S functional capabilities contained in Appendix C to attaining the Marine Corps' M&S end states, and (3) capabilities that cannot be obtained by leveraging other efforts. M&S technology procurement during the FY95-FY97 time frame will be accomplished primarily through non-Marine Corps funding by agencies such as the Defense Modeling and Simulation Office and the Advanced Research Projects Agency. M&S technology procurement during the FY98-FY10 time frame will be incorporated in the Marine Corps POM process and will also include non-Marine Corps funding. The technology thrusts identified in the table are grouped into three year increments. The required beginning of funding for an effort is denoted by the "▲" symbol and successful achievement of a full operational capability (FOC) by the "▼" symbol. The "∇" is used to denote the initial operational capability (IOC) for the joint simulation system. Details and funding priorities for the different efforts for each three year period are provided in the following five subsections. The infrastructure required to support the various M&S efforts is also addressed in the subsections.

The Marine Corps intends to rely heavily on leveraging Jointly-sponsored and the other Services' efforts in meeting their M&S requirements. The successful development and fielding of a joint simulation system for training and analysis is of paramount importance to the Marine Corps. This project, more than any other effort, is envisioned as providing the majority of the M&S functional capabilities identified in Appendix C, the majority of the ADS infrastructure, and a realistic synthetic battlefield for use by the Marine Corps.

Table 3-1. Marine Corps M&S Technology Thrusts

M&S Technology Thrusts	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10
Instrumented Exercises MCAGCC (Demo)	▲	▼														
Instrumented Exercises LWTC (Demo)	▲	▲	▼													
Develop Deployable Aircraft Simulators	▲	□	▼													
Instrumented Live Exercises	▲	□	□	□	□	▼	▼									
MAGTF Training Simulation	▲	□	□	□	□	□	□	□	▼							
Simulation Engine Development	▲	□	□	□	▼											
Scenario Generator Development	▲	□	□	□	▼											
Joint Simulation System		▲	□	□	▼	□	□	□	▼							
Develop Marine Specific Objects	▲	□	□	□	□	□	□	□	▼							
Develop Marine Specific Behaviors	▲	□	□	□	□	□	□	□	▼							
Develop Littoral Data Base	▲	□	□	□	□	▼										
Develop 2-D Mission Planning System (Grd)	▲	▼														
Develop 3-D Mission Planning System (Grd)		▲	▼													
Develop Virtual Prototype				▲	□	▼			▼							
Develop Reconfigurable Simulator					▲	□	□	□	□	□						
Develop Deployable Ground Weapon Platform Simulators						▲	□	□	□	□	▼					
Develop Deployable Individual Ground Combatant and Small Unit Simulators							▲	□	□	□	□	▼				
Develop Reconfigurable, Deployable Aircraft Simulators								▲	▲	□	□	□	□	▼		

The emphasis during the first three years of the plan is on providing the Marine Corps with the capability to conduct instrumented live exercises, developing an initial analytical capability, and developing a mission planning system that forms the basis for developing a mission preview and rehearsal capability in the out years. Most of the Marine Corps efforts during the next six years will be directed toward supporting the development of the joint simulation system through joint sponsorship of the program and toward developing Marine Corps unique objects and applications to support its analytical requirements. The last seven years of the plan are devoted to developing deployable simulators and a globally accessible synthetic environment.

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Section 3.2

FY95 Through FY97

The M&S emphasis for FY95 through FY97 will be on (1) obtaining an initial capability for conducting instrumented exercises and MAGTF staff training, (2) developing an analysis and mission preview capability and (3) providing support for a joint simulation system.

Table 3-2 provides a prioritized list of planned Marine Corps M&S efforts for the FY95-FY97 time period. These efforts will be accomplished primarily through non-Marine Corps funding. Factors used in determining the prioritization of the various thrusts included: (1) importance to obtaining the end states as measured by the weighted tables contained in Appendix C, (2) criticality to obtaining follow-on operational capabilities, and (3) amount of high-level interest within the Marine Corps.

Table 3-2. M&S Prioritized Efforts for the Period FY95-FY97

M&S Technology Thrusts	FY 95	FY 96	FY 97
Instrumented Exercises MCAGCC	1	1	
Instrumented Exercises LWTC		2	1
Instrument Live Exercises	2	3	3
Develop Deployable Aircraft Simulators	3	4	2
MAGTF Training Simulation	4	5	4
Scenario Generator Development	5	6	5
Simulation Engine Development	6	7	6
Joint Simulation System		8	7
Develop Marine Specific Objects	7	9	8
Develop Marine Specific Behaviors	8	10	9
Develop Littoral Data Base	9	11	10
Develop 2-D Mission Planning System (Ground)	10	12	
Develop 3-D Mission Planning System (Ground)		13	11

As indicated, the top priority for this period is the demonstration of instrumented exercises at the Marine Corps Air-Ground Combat Center (MCAGCC) and the Littoral Warfare Training Complex (LWTC). This effort includes attaining the necessary instrumentation, data processor and display capability, and establishing the required communications infrastructure. This capability will enable platoon to MEF commanders to more readily identify unit strengths and weaknesses, resulting in a better assessment of a unit's readiness, as well as an enhanced evaluation and validation of Marine Corps doctrine and tactics by facilitating more deliberate analysis. Moreover, electronic recordings of training exercises will document and support requirements development which is a high visibility endeavor. These two demonstrations will provide the basis for continued efforts to obtain a capability to conduct instrumented live exercises at both east and west coast facilities on a continuing basis.

The next M&S thrust in terms of priority is the development of deployable aircraft simulators which will extend aircrew training capabilities in terms of the number of air platforms supported as well as the types of training that can be conducted while aboard ship and forward deployed.

The recent establishment of the MAGTF Staff Training Program (MSTP) is indicative of the importance being placed on MAGTF staff training within the Marine Corps. The development and fielding of a constructive simulation that will drive MAGTF staff exercises is vital to the success of this effort. This simulation will also provide the basis for defining and validating the Marine Corps' operational requirements for a joint simulation system.

Development of a scenario generator and a simulation engine will support the development of Mission Previewing Systems indicated later in the priority list. This capability will be provided by an object-oriented commercial-off-the-shelf (COTS) product. This product, in conjunction with development of Marine specific objects and behaviors, will provide the Marine Corps with the underpinnings for selection of the "best of the best" in support of the joint simulation system. It also provides an analytical capability that will support "what if" analysis for mission preview and a constructive simulation to support the validation of Marine Corps requirements and doctrine scheduled for the next three year period. This effort

will also provide the Marine Corps with an additional constructive simulation that could be used to drive MAGTF staff training.

The realistic modeling of the littoral area is vital to the Marine Corps. This is one operational area that is unique to the Marine Corps and strongly supports the doctrine presented in "Forward...From the Sea". However, it is currently receiving very little attention. The Marine Corps will have to champion this effort to ensure its requirements for a realistic littoral representation are developed and available for use.

Development of the 2-dimensional (2-D) mission planning system followed by a 3-D capability will provide Marine ground commanders and planners with the same type of capability that currently exists within Marine Aviation. They also form the foundation for follow-on development of mission preview and rehearsal capabilities for ground combatants in the out-years.

Infrastructure issues to support these efforts include the following: hardware suites to support data processing and display for the instrumented exercises at MCAGCC and LWTC, and facilities to house them; hardware suites for mission preview; and hardware suites to support development of the Marine Corps analytical capability which include the scenario generator, simulation engine, and Marine specific objects and behaviors.

Communications networks need to be established that will support the conduct of advanced distributed simulations (ADS) within the Marine Corps. During network design, several factors should be considered including the impact of Defense Information Systems Network (DISN) upgrades on the base infrastructure (IDNX multiplexers), and competing bandwidth requirements between supporting establishments and the operating forces. Remote site/in-transit connectivity requirements should also be addressed to facilitate reaching modeling and simulation goals. Specifically, bases/stations will be required to accommodate ADS protocols (ST-II/PDU) associated with the Defense Simulation Internet and a minimum of 1.5 Mbps bandwidth (T-1) near term and eventually as much as 155 Mbps (T-3/SONET/ATM) for the future.

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Section 3.3

FY98 Through FY00

The Marine Corps will continue to emphasize support for a joint simulation capability and initiate M&S efforts directed at improving the combat development and acquisition processes.

The primary emphasis during the FY98-FY00 time frame is support of the joint simulation system development effort, the conduct of instrumented live exercises, and continued development of Marine specific objects, behaviors, and applications that extend the Marine Corps' analytic capabilities to support validation of requirements and doctrine. New efforts include development of virtual prototypes and reconfigurable simulators to support improvement of the combat development and acquisition processes. Table 3-3 provides a prioritized list of M&S efforts for this period.

Table 3-3. M&S Prioritized Efforts for the Period FY98-FY00

M&S Technology Thrusts	FY 98	FY 99	FY 00
Joint Simulation System	1	1	1
Conduct Instrumented Live Exercises	2	2	2
Develop Marine Specific Objects	3	3	3
Develop Marine Specific Behaviors	4	4	4
Develop Littoral Data Base	5	5	5
Scenario Generator Development	6	6	
Simulation Engine Development	7	7	
Develop Virtual Prototype	8	8	6
Develop Reconfigurable Simulator		9	7
Develop Deployable Ground Weapon Platform Simulators			8
MAGTF Training Simulation	9	10	9

Support for development of the joint simulation system is the top priority for this period and will remain the top priority until fielding of a FOC version during the next period. As previously stated, this project, more than any other effort, is envisioned as providing the majority of the M&S functional capabilities identified in Appendix C, the majority of the ADS infrastructure as well as a realistic synthetic battlefield for use by the Marine Corps. It will provide the Marine Corps with the capability to participate in joint training exercises as well as provide the means for conducting Marine Corps specific MAGTF staff training. The Marine Corps will continue to fund limited development of the MAGTF training simulation to ensure a continued and adequate capability to conduct MAGTF staff training exists in case expectations for the joint system do not reach full fruition or time delays are experienced. This is the primary reason the MAGTF training simulation fell to and will remain at the bottom of the priority list.

The Marine Corps will continue to procure the instrumentation, data processing and display capabilities, and to establish the required communications and range instrumentation infrastructure necessary to conduct instrumented live exercises on both coasts. The Marine Corps will also continue to expand its analytical capability to support the requirements and doctrine validation process by continuing to develop Marine specific objects and behaviors. Although the joint simulation system is envisioned to provide an analytical capability, this will probably not be available until close to FOC in FY03, since the main emphasis for this system is on training. The Marine Corps needs an initial capability by FY98 to support "what if" analysis for mission planning and a full capability during FY99 to support validation of requirements and doctrine. Realistic modeling of the littoral regions of the world are also vital to these two capabilities as is the 3-dimensional (3-D) representations of these regions to support the mission preview/rehearsal and training capabilities for the out years. Thus, the relatively high priority assigned to development of the littoral database.

The scenario generator and simulation engine need to be completed during FY99 as part of the constructive simulation effort to support validation of Marine Corps requirements and doctrine. The priorities assigned to the remaining items were based solely on the chronological order of the milestones they support, i.e., highest priority to the thrust that supports the closest milestone, and the lowest to the one that supports the farthest milestone.

Section 3.4

FY01 Through FY03

Funding priorities for the period FY01 through FY03 will be split between bringing the joint simulation system to full operational capability and development of deployable simulators.

A prioritized list of M&S efforts for the period FY01 through FY03 is provided in Table 3-4. Efforts during this period will be concentrated in two areas: (1) continued support for the development of the joint simulations systems including the continued development of Marine unique objects and applications; and (2) development of deployable simulators that will allow Marine Corps units to train regardless of whether they are at home station, aboard ship, or forward deployed. Efforts to develop reconfigurable simulators will concentrate on the development of a generic simulator for ground weapon platforms, fixed wing aircraft, and rotary wing aircraft.

Table 3-4. M&S Prioritized Efforts for the Period FY01-FY03

M&S Technology Thrusts	FY 01	FY 02	FY 03
Joint Simulation System	1	1	1
Conduct Instrumented Live Exercises	2		
Develop Marine Specific Objects	3	2	2
Develop Marine Specific Behaviors	4	3	3
Develop Deployable Ground Weapon Platform Simulators	5	4	4
Develop Deployable Individual Ground Combatant and Small Unit Simulators	6	5	5
Develop Reconfigurable, Deployable Aircraft Simulators			6
Develop Reconfigurable Simulator	7	6	7
MAGTF Training Simulation	8	7	8

Support for development of the joint simulation system remains the number one priority for this period for the same reasons as provided in the previous subsection. The Marine Corps will continue to develop Marine specific objects and behaviors to expand its analytical capability and, if necessary, to support the joint simulation system.

Deployable simulators are essential if the Marine Corps is to conduct training, mission preview or mission planning while units are aboard ship or forward deployed. The priorities assigned to the development of deployable simulators were based solely on the chronological order of the milestones they support, i.e., highest priority to the thrust that supports the closest milestone, and the lowest to the one that supports the farthest milestone.

Section 3.5

FY04 Through FY06

Funding for FY04 to FY06 focuses on developing deployable simulators and a mission preview and rehearsal capability for all elements of the MAGTF.

As indicated in Table 3-5, M&S efforts for the FY04-FY06 time frame will continue to focus on developing deployable simulators. The priorities assigned to the development of deployable simulators were based solely on the chronological order of the milestones they support, i.e., highest priority to the thrust that supports the closest milestone, and the lowest to the one that supports the farthest milestone.

Infrastructure efforts will focus on the linking of live instrumented exercises, constructive models, and virtual simulators to form a common synthetic battlefield that will allow the Marine Corps to exercise a MAGTF from the individual Marine level to the MEF as part of joint or combined operation. This also implies the capability to conduct mission preview and mission rehearsal in a distributed environment.

Table 3-5. M&S Prioritized Efforts for the Period FY04-FY06

M&S Technology Thrusts	FY 04	FY 05	FY 06
Develop Deployable Ground Weapon Platform Simulators	1	1	
Develop Deployable Individual Ground Combatant and Small Unit Simulators	2	2	1
Develop Reconfigurable, Deployable Aircraft Simulators	3	3	2

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Section 3.6

FY07 Through FY10

Efforts from FY07 to FY10 will center on extending the MAGTF training, mission preview, and mission rehearsal capability to units that are aboard ship and forward deployed.

As indicated in Table 3-6, M&S efforts for this last four year period will concentrate on fielding reconfigurable, deployable aircraft simulators. Infrastructure issues will be concerned with establishing the networks needed to support a global capability to train, conduct mission previews and rehearsals on a common synthetic battlefield. A particular emphasis will be on ensuring that all simulators for major Marine Corps weapons systems are linkable into the synthetic environment and can participate in training for joint and combined operations. Efforts to utilize operational C4I systems to the maximum extent feasible for the conduct of simulations will also be completed during this period.

Table 3-6. M&S Prioritized Efforts for the Period FY07-FY10

M&S Technology Thrusts	FY 07	FY 08
Develop Reconfigurable, Deployable Aircraft Simulators	1	1

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Section 3.7

Aviation Ranges FY95 Through FY04

Efforts to enhance aviation ranges during the period FY95 through FY04 will significantly enhance the Marine Corps capability to conduct instrumented exercises for Marine Aviation.

The aviation tactical training range instrumentation plan provides a realistic combat training environment through simulations (computer modeling of weapons employment, and weapons and electronic warfare countermeasures); stimulation (computer generation of sensor targets and threat signals); combat systems data collection; and position tracking for all aviation participants. By stressing interoperability with other services' and Department of the Navy (DON) tactical training range systems, the Marine Corps can maximize training opportunities and enhance operational readiness. Major program initiatives for aviation ranges include:

Advanced Display and Debriefing Subsystem (ADDS). ADDS is a joint project to replace existing Tactical Aircrew Combat Training System (TACTS) display and debriefing subsystems (DDS) with a new generation of commercially available displays with solid fill graphics utilizing state of the art technology that allows for remote debriefing over STU-III phones.

Joint Tactical Combat Training System (JTCTS). JTCTS is a joint program designed to replace existing Tactical Aircrew Combat Training System (TACTS) ranges. JTCTS is a Global Positioning System (GPS) based system capable of tracking 100 aircraft, 24 ships, and 6 submarines. JTCTS provides a realistic combat environment enhanced by simulated threat representation, scenario development, exercise monitoring and control, and timely debriefing.

Cherry Point - Oceana TACTS Range Consolidation. The consolidation of the Cherry Point - Oceana TACTS ranges with the control and computation subsystem (CSS) at Cherry Point allows for continuous tracking of aircraft flying from the existing Oceana TACTS Range southward to the existing Cherry Point TACTS Range.

Camp Lejeune TACTS Range Expansion. Expansion of the Cherry Point - Oceana TACTS Range over Camp Lejeune provides no drop bomb scoring (NDBS) for the Camp Lejeune target areas. The expansion will also permit integration of EW threats in the Camp Lejeune complex to support simulated stand-off weapons employment.

Weapons Impact Scoring Sets. AN/FXQ-3 (V) Weapons Impact Scoring Set (WISS) is an optical scoring system that provides scoring capabilities for inert and live weapons deliveries. The new WISS systems replace outdated WISS and provide for more rapid and accurate scoring of multiple bomb drops in highly complex target areas.

The schedule for planned enhancements to aviation ranges is provided in Table 3-7. The letter "I" denotes an initial operational capability (IOC), a "P" stands for planned, and a "F" indicates funded.

Table 3-7. Aviation Range Enhancements Schedule

Planned Range Enhancement	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04
MCAS Beaufort										
ADDS	I									
WISS (Townsend)			I							
JTCTS										I
MCAS Cherry Point										
ADDS	I									
TACTS consolidation with Oceana	I									
Expansion Camp Lejeune TACTS		P								
WISS			I							
Range Operations Center	F									
MACCS/LAAM/LAAD Integration	F									
Comm Suite/UHF SATCOM		P								
MAEWR EW Upgrade			P		P	P				
JTCTS						I				

Table 3-7. Aviation Range Enhancements Schedule (Concluded)

Planned Range Enhancement	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04
MCAS Yuma										
ADDS (Yuma, El Toro)	I									
EW Emitters and Avenger	F									
EW Emitters		P								
TACTS Low-Altitude Tracking		P								
WISS		I								
WISS (Chocolate Mountains)				I						
JTCTS							I			

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Appendix A

Marine Corps M&S Programs

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Appendix A.1

Introduction

This appendix describes significant current and planned Modeling and Simulation (M&S) efforts that involve the Marine Corps. Table A-1 identifies and summarizes these efforts by providing a brief description and categorization of the project, costs associated with acquisition of the system, and a point of contact. The remainder of this appendix provides additional narrative information on these efforts, the descriptions of which include (where available) the: (1) purpose of the program, (2) approach being taken, (3) related projects and activities, (4) platform requirements, (5) current status of the project, and (6) project schedule. The projects are presented in alphabetical order. Note "TBD" indicates that the required information is to be determined. As applicable information is made available, the Investment Strategy will be updated accordingly.

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Table A-1. Summary of M&S Projects Involving the Marine Corps

PROGRAM	PURPOSE	M&S Class ¹	COSTS	POINT OF CONTACT
AAAV	The Advanced Assault Amphibious Vehicle (AAAV) is a DMSO-funded pilot M&S program to streamline test & evaluation within the acquisition process.	None	TBD	Mr. Mark Delmonico Office of the Direct Reporting Program Manager AAA Voice: (703) 696-1119 Fax: (703) 696-1117
CVAT	The Combat Vehicle Appended Trainer (CVAT) is a class of deployable, multi-purpose simulators that can be appended to combat vehicles.	CM, IS, RBR, RPER, RPRS, IS, SE, SM	TBD	CWO-4 Scott Hamilton MARCORSYSCOM (SST) Quantico, VA 22134 Voice: (703) 640-2886
DEEM	The Dynamic Environmental Effects Model (DEEM) is a DMSO-funded project to expand the synthetic environment to model features of urban terrain and complexity of structure and physical objects.	CM, IS, RPER, RPRS, IS, SE, SM	TBD	Mr. Joe Santilli Naval Air Warfare Center Training Systems Division (NAWCTSD) 12350 Research Parkway Orlando, FL 32826-3224 Voice: (407) 380-4234 Fax: (407) 381-8807
DFO/MULE	The Deployable Forward Observer/Modular Universal Laser Equipment (DFO/MULE) is an OSD-funded R&D prototype high-fidelity training device for FOs, FACs, NGSS, and MULE operators.	CM, IS, RBR, RPER, RPRS, IS, SE, SM	TBD	Mr. Durwood Freer Naval Air Warfare Center Training Systems Division (NAWCTSD) 12350 Research Parkway Orlando, FL 32826-3224 Voice: (407) 380-4234 Fax: (407) 381-8807
FO/FAC	The Forward Observer / Forward Air Controller (FO/FAC) is an ATD to develop and demonstrate a man-portable, integrated surveillance/target acquisition/communication system for use by FOs and FACs.	CM, IS, RBR, RPER, RPRS, IS, SE, SM	TBD	Maj Frank Wysocki MARCORSYSCOM (AW) Quantico, VA 22134 Voice: (703) 640-2761 Fax: (703) 640-2764

¹ The M&S Capability Classes are discussed in detail in Appendix C.

Table A-1. Summary of M&S Projects Involving the Marine Corps (Continued)

PROGRAM	PURPOSE	M&S Class	COSTS	POINT OF CONTACT
ICSS	The Individual Combatant Simulation System (ICSS) is a DMSO-funded project to model and monitor realistic behavior of individual combatants and insert in an operationally relevant distributed and dynamic synthetic environment.	RBR, SG, SE, SM	TBD	Mr. Joe Santilli Naval Air Warfare Center Training Systems Division (NAWCTSD) 12350 Research Parkway Orlando, FL 32826-3224 Voice: (407) 380-4234 Fax: (407) 381-8807
JSIMS	Joint Simulation System (JSIMS) will develop and build a joint simulation system to support Joint and Service training and analysis through an infrastructure of battlespace representations, simulation management and support services that interact with the user through operational C4I systems.	SE and basic structure	TBD	CAPT Mark Falkey, USN JSIMS Joint Program Office 3045 Technology Parkway Orlando, FL 32826-3299 Voice: (407) 282-6700 Fax: (407) 658-6078
JTCTS	Joint Tactical Combat Training System (JTCTS) is a joint Navy- Air Force program designed to provide a realistic combat environment for instrumented training and debrief.	CM, IS, RBR, RPER, RPPS, SE, SG	TBD	CAPT Joe Heineiman, USN NAVAIRSYSCOM (pma-248) Voice: (703) 604-1414, ext 8421 Fax: (703) 604-1461
LeatherNet	LeatherNet is an ARPA-led project to develop the capability for tens of thousands of entities (from live, virtual and constructive simulations) to interact in a synthetic environment.	IS, RBR, RPER, SE	TBD	Mr. Mack Brewer MCAGCC Twentynine Palms, CA Voice: (619) 830-1910
MCTFIST	The Marine Corps Tank Full-Crew Interactive Simulation Trainer (MCTFIST) is a deployable appended tank simulator that enables crew members to train as an integral unit using the actual vehicle in which they will fight.	CM, IS, RBR, RPER, RPRS, IS, SE, SM	TBD	MGySgt Will Henson MARCORSYSCOM (SST) Quantico, VA 22134 Voice: (703) 640-2886

Table A-1. Summary of M&S Projects Involving the Marine Corps (Concluded)

PROGRAM	PURPOSE	M&S Class	COSTS	POINT OF CONTACT
MTWS	The MAGTF Tactical Warfare Simulation (MTWS) is a computer-assisted tactical C2 training system for the MAGTF commander and staff.	CM, IS, RBR, RPER, RPRS, IS, SE, SM	TBD	Maj Connally MARCORSYSCOM (SST) Quantico, VA 22134 Voice: (703) 640-2886
TAMPS	The Tactical Aircraft Mission Planning System (TAMPS) program is designed to prepare Navy and Marine Corps aircrews for successful mission performance in Joint arena actions.	CM, IS, RBR, RPER, RPRS, IS, SE, SG, SM	TBD	Maj Al Womble, USMC NAVAIRSYSCOM, PMA-233 Voice: (703) 604-1450, ext 8446 Fax: (703) 604-1464
TOPSCENE	The Tactical Operational Preview Scene (TOPSCENE) system provides Navy and Marine aircrew with a 3-D fly-through mission preview capability utilizing imagery databases.	CM, IS, RBR, RPER, RPRS, SE, SG, SM	TBD	Ms. Phylis Corley, NAVAIR (PMA-205) Voice: (703) 604-2245, ext. 3072 Fax: (703) 604-2153
TTES	The Team Target Engagement Simulator (TTES) program is an ATD to demonstrate a core technology that allows individual combatants and small units to conduct force-on-force engagements in a synthetic urban environment.	CM, IS, RBR, RPER, RPRS, IS, SE, SG, SM	TBD	Major Frank Wysocki MARCORSYSCOM (AW) Quantico, VA 22134 Voice: (703) 640-2761 Fax: (703) 640-2764 Dr. Fowlkes Naval Air Warfare Center Training Systems Division (NAWCTSD) 12350 Research Parkway Orlando, FL 32826-3224 Voice: (407) 380-4234 Fax: (407) 381-8807

Legend:

CM - Constructive Models
 IS - Instrumented Systems
 RBR - Realistic Behavioral Representations
 RPER - Realistic Physical Environmental Representations
 RPRS - Realistic Physical Representations of Systems
 SE - Simulation Engine
 SG - Scenario Generator
 SM - Simulators

Appendix A.2

AAAV

Purpose. Using the Advanced Amphibious Assault Vehicle (AAAV) program as a case study, this project will examine the application of present and future M&S tools to the acquisition process. The intent is to demonstrate the feasibility of using M&S to reduce acquisition costs and increase operational effectiveness. If the study objectives are met, this project will guide future Major Defense Acquisition Programs (MDAP) in developing alternative acquisition strategies. Particularly, this project moves the Marine Corps closer to satisfying End State 5 (i.e., improvement to the Department of Defense (DOD) acquisition process by simulating before buying or building) articulated in the Modeling & Simulation Master Plan.

Approach. The Institute for Defense Analysis (IDA) will analyze available M&S resources and tools, paying particular attention to Distributed Interactive Simulation (DIS) applications. The feasibility study will address what tools are applicable for accelerating or improving the acquisition process.

There are two objectives for this project:

- Develop a strategy for incorporating DIS M&S tools into the overall acquisition process.
- Determine if the number of hardware prototypes can be reduced while still satisfying the test and evaluation (T&E) requirements of the T&E Master Plan (TEMP).

Related Projects and Activities. This feasibility study is not directly related to any other effort. However, it will consider several M&S areas during the search for applicable DIS M&S tools. Particular attention will focus on virtual prototyping.

Platform Requirements. TBD.

Current Status of the Project. The Defense Modeling and Simulation Office (DMSO) has advanced funding to the office of the AAAV Direct Reporting Program Manager (DRPM). Work on the project is pending completion of the Statement of Work (SOW).

Project Schedule. TBD.

Appendix A.3

CVAT

Purpose. The Combat Vehicle Appended Trainer (CVAT) program intends to procure a family of multi-purpose, deployable simulators that can be appended to all types of combat vehicles. This effort will allow full-crew and individual gunnery skills training in a synthetic environment while embarked, forward deployed, and in garrison.

Approach. TBD.

Related Projects and Activities. The Deployable Turret Trainer (DTT) Advanced Technology Demonstration (ATD) and the Marine Corps Tank Full-Crew Interactive Simulator Trainer (MCTFIST) are ongoing efforts that parallel the CVAT.

Platform Requirements. TBD.

Current Status of the Project. TBD.

Project Schedule. TBD.

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Appendix A.4

DEEM

Purpose. The Dynamic Environmental Effects Model (DEEM) is a multi-Service and J-8 project, funded by DMSO and several other sponsors, intended to provide a generalized object-oriented framework to support existing and emerging models for dynamic processes in environmental representation.

Approach. DEEM will provide DIS compliant virtual environment dynamic structures, atmospheric models and environmental scalability. The micro-terrain application will be integrated into the Team Target Engagement Simulator (TTES) and the Individual Combatant Simulator System (ICSS) programs. This will dynamically support the training of individual combatants and small units in high-fidelity virtual maneuver battlefields or close combat environments. Dynamic munitions effects will take place against urban structures. The macro-terrain applications will provide analytical tools for DOD and Joint Staff analysis of regional and theater-level plans and contingencies.

Related Projects and Activities. DEEM technology will be utilized in the TTES and ICSS.

Platform Requirements. TBD.

Current Status of the Project. Ongoing; demonstrations of real-time munitions effects on buildings for TTES occurred in FY94; demonstrations of environmental effects on mobility and avenues of approach, and of weather effects on mobilization schedules are projected for FY95.

Project Schedule. Deliverables have been identified through FY96; funding requirements have been identified through FY01.

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Appendix A.5

DFO/MULE

Purpose. The DFO/MULE is an R&D prototype high-fidelity training device, funded by OSD, to train FACs, FOs, naval gunfire spotters (NGSs), and MULE operators. It captures all of the artillery training capabilities of the Training Set Fire Observation (TSFO) in a compact deployable package, plus provides basic and sustainment training for the other personnel mentioned above. Digital Communications Terminal (DCT) training is also provided through the use of operational DCTs and tutorial software.

The DFO/MULE is designed to operate in either a "stand alone" or as a component of a DIS compliant network for combined arms training. It can be modified into three different configurations: a deployable trainer; an institutional domed trainer; and a classroom trainer. DFO/MULE's DIS compliancy allows for tactical air control party (TACP) training in a distributed virtual environment (linked to dislocated aircraft simulators). Additionally, the DFO/MULE will provide the virtual environment for MARCORSYSCOM (AW) to develop and test the 21st Century Land Warrior FO/FAC device.

Approach. In August 1990, a DFO/MULE Program Development Plan (PDP) was developed by the Naval Air Warfare Center Training Systems Division (NAWCTSD) (formerly the Naval Training Systems Center) and submitted to OASD (FM&P). The Plan was approved and funding set for FY91 - FY93. In August 1991, a contract was awarded to Invertron Simulated Systems, Ltd., the developer and builder of the TSFO devices used by the Marine Corps and the Army. A DFO/MULE stand-alone (non-DIS compliant) prototype was delivered on 24 September 1993; DIS modifications have since been performed by Southwest Research Institute. In May 1994, the DFO/MULE was successfully linked into the

Multi-Service Distributed Training Testbed (MDT2) via a DIS interface during a DMSO exercise.

Several Pre-Planned Product Improvements (P3I) have been identified for the DFO/MULE. P3I-1 seeks to add the capability to generate terrain background from satellite data sources to the existing capability of photographic terrain, thus enhancing the Mission Rehearsal and DIS capabilities. P3I-2 seeks to use the DFO/MULE as a FO/FAC testbed, allowing its high resolution target models to be leveraged for other programs. P3I-3 intends to develop a simulated binocular interface for the DFO/MULE, thereby providing three separate video display channels which will further enhance coordinated team training capability. P3I-4 will add a voice recognition system to the DFO/MULE trainer, allowing the system to automatically recognize and respond to student commands which reduces the instructor workload and increases training effectiveness. P3I-5 will improve the system's transport case.

Related Projects and Activities. DFO/MULE has been identified as a technology feeder for the Lightweight Laser Designator Rangefinder (LLDR), and for two ATDs, the Deployable Crew-Served Weapons Trainer (DCSWT) and the Deployable Advanced Fire Observation Simulator (DAFOS).

Platform Requirements. The minimum DFO/MULE configuration requires an area no smaller than 12' x 8'. In addition to the laser designator itself, a high-resolution video projector, portable screen, loudspeaker, DCT, student track ball, and MULE repeat monitor make up a typical configuration, hosted by a PC utilizing a 60 mhz Pentium CPU, Real Time (IRMX) operating system, and Windows 3.1.

Current Status of the Project. TBD.

Project Schedule. TBD.

Appendix A.6

FO/FAC

Purpose. The Forward Observer/Forward Air Controller (FO/FAC) system concept is that of an accurate, easily man-portable, user friendly, integrated target acquisition/communications system that will provide all the functional capabilities FOs and FACs need to accomplish their missions (current and future). They will have the capabilities to quickly and accurately detect and locate targets for field artillery, close air support, and naval fire support, and to communicate the required targeting data (in digital format) over tactical radios.

Approach. As presently envisioned, the FO/FAC system will integrate a GPS receiver, an eye-safe laser rangefinder, a vertical angle (tilt) sensor, a target azimuth sensor, a small tactical computer, an embedded communications processor, and a day/night vision capability. The technical approach is to employ a systems engineering methodology to ensure that the design and development process is driven by, and is responsive to, clearly defined FO/FAC system requirements. DFO/MULE will be utilized as a virtual prototyping tool to define, refine and validate performance requirements.

Related Projects and Activities. DFO/MULE is an ongoing effort related to FO/FAC.

Platform Requirements. TBD.

Current Status of the Project. During FY94, a contract was awarded based on a preliminary design; the contractor was funded to continue on through detailed design, fabrication, and test and evaluation. DT-0 testing also began in FY94. The PM for Ground Weapons has been identified as the prospective PM for FO/FAC.

Project Schedule. During FY95 DT-0 testing will be completed; OT-0 is scheduled to begin.

MSs I, II, and III are scheduled for the beginning of FYs 96, 98, and 01, respectively. The FO/FAC system has an IOC of FY02.

Appendix A.7

ICSS

Purpose. The Individual Combatant Simulation System (ICSS) is a multi-Service project, funded by DMSO and several other sponsors, with the goal of identifying, developing, and implementing a representative set of sufficiently realistic hostile behaviors at the individual combatant level to permit effective Military Operations in Urban Terrain (MOUT) training on a synthetic battlefield. ICSS will insert the individual combatant into the DIS compliant virtual maneuver battlefield or close combat environment. This effort includes developing a more realistic human interface. In addition, ICSS will develop a more accurate representation of hostiles, neutrals, and friendlies in a dynamic synthetic environment.

Approach. The ICSS effort has been task organized into eight different tasks. Task leaders represent the US Air Force, the ARI, and the NAWCTSD; performers include those same organizations plus the Naval Postgraduate School, the University of Pennsylvania and the Institute for Simulation and Training (IST). Implementation relies heavily on leveraging the lessons learned, technology, and behavioral models from other projects, such as LeatherNet. The Team Target Engagement Simulator (TTES) has been used as a testbed for implementing, testing, validating, and demonstrating the developed behavioral representations. Subject matter experts have also been used to define and validate the behavioral representations. Specific objectives for measuring the success of various aspects of this project are:

- Develop appropriately realistic and explicitly described object behaviors for combatants and noncombatants engaged in MOUT.

- Display the capability to model tactical consideration and combat missions on behavioral response within a synthetic environment.
- Display the capability for dynamic interaction between combatants based upon stimuli emanating from the synthetic environment.
- Develop behavioral models that are easy to update and modify.

Related Projects and Activities. TTES will serve as a testbed for elements of ICSS.

Platform Requirements. TBD.

Current Status of the Project. Funding was released in May 1994 and has been applied. Work is ongoing throughout all tasks.

Project Schedule. Required funding has been identified through FY01. The potential exists for ICSS to support elements of the Army's 21st Century Land Warrior experiment in FY95.

Appendix A.8

JSIMS

Purpose. The Joint Simulation System (JSIMS) will develop and build a joint simulation system to support Joint and Service training and analysis through an infrastructure of battlespace representations, simulation management and support services that interact with the user through operational C4I systems.

Approach. To accomplish the mission stated for JSIMS, development will follow an approach that considers the objectives as follows:

- Interoperability: Integrate the range of Service missions within a common M&S framework, including live, virtual and constructive simulations, and eventually capable of addressing training, testing and analytic needs.
- Resolution: Create a training environment at the operational level capable of supporting requirements at the strategic and tactical levels.
- Common Simulation Framework: Establish a common simulation support structure, and allow harmonious sharing of simulation resources, processes and results.

JSIMS design will feature object-oriented concepts, using commercial off-the-shelf (COTS) software where appropriate. An open architecture is specified — the design considers distributed technologies such as Object Request Broker (ORB). Finally, the JSIMS design stresses reuse and portability of components. This reduces duplication of effort while allowing leverage of simulation components by other organizations.

The initial JSIMS application area will focus on training at the campaign level. Other application areas include analysis and test & evaluation. If the vision of JSIMS is fulfilled, the full range of M&S capability will be realized. This range of capability is defined by Hierarchy of Model (Engineering, Engagement, Mission, Battle, Campaign), Class (Live, Virtual, Constructive), and Functional Area (Education, Training, and Military Operations (ETMO), Analysis, Research and Development (R&D), Test and Evaluation (T&E), and Production and Logistics). Within the capability range so defined, each M&S application can be further classified according to the time management method, degree of distribution and computational complexity. The JSIMS Joint Program Office (JPO) anticipates the ability to satisfy the entire capability range of M&S.

Note. JSIMS is intended to be a "capstone" system to provide interoperability between existing models and systems. JSIMS will not be a "super-monolithic" model.

Related Projects and Activities. The approach for JSIMS development includes collaborative efforts with the Services, DMSO, ARPA and the Joint Warfare Center (JWC). DMSO coordinates the collaboration effort. Examples of collaboration include: Synthetic Theater of War (ARPA), WARSIM 2000 (USA), Joint Modeling and Simulation System (USAF), and the Naval Simulation System (USN). Related to the collaborative effort, each Service must identify the "best of the best" modeling and simulation efforts currently underway. The JSIMS JPO will harvest applicable algorithms, technologies and simulation representations.

Platform Requirements. TBD.

Current Status of the Project. JSIMS JPO was authorized in June 1994 by a Joint Memorandum of Agreement (MOA) among the four Services and OSD. A JSIMS Mission Needs Statement (MNS) was released on 20 July 1994. On 7 November 1994, the JSIMS Charter, draft JSIMS Operational Requirements Document (ORD) and draft JSIMS Master Plan were published. Currently, JSIMS is

in Phase 0, Concept Exploration & Definition. A MS O/I decision for movement into Phase I, Demonstration and Validation is planned for the third quarter of FY95.

Product Schedule. The MS I/II decision is based on a Proof of Principle-Demonstration (POP-D). The JSIMS distributed test bed will demonstrate the POP-D prototype in 1996. The objective of Phase II, Engineering and Manufacturing Development, is the delivery of a JSIMS Initial Operational Capability (IOC) by 1999. Final Operational Capability (FOC) is planned for 2003. JSIMS effort will populate the architecture for JTF training configuration by 1999, and service components by 2003. Additional scheduling information is provided in Table A-2.

Table A-2. JSIMS Schedule

FY94	FY95	FY96	FY97	FY98	FY99
Develop JSIMS RFP	Prototype ADS Architecture Develop Architectural Standards & Guidelines		System Level Requirements System Level Specification	JSIMS PDR	JSIMS CDR
Develop Functional Requirements	Input to STOW Program	Refine Technical Requirements		Technology Infusion	Requirements Update

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Appendix A.9

JTCTS

Purpose. The Joint Tactical Combat Training System (JTCTS) is a joint Navy - Air Force program designed to provide a realistic combat environment enhanced by threat representation, scenario development, ground truth determination, exercise monitoring and control, and timely feedback and debrief. JTCTS is scheduled to replace TACTS and take tactical training ranges into the 21st Century.

Approach. JTCTS is a GPS-based system that uses distributed processing in an RF environment to support basic through advanced force training. JTCTS will use an open architecture and portable software that will allow for future external systems integration and straight forward system enhancements as future requirements are identified.

The JTCTS core system will monitor each participant's position, weapon system activity, and engagement results. It will update and coordinate a common simulated scenario with the other participants and establish a ground truth database from all interfaced sources. Each participant's instrumentation unit will determine the participant's GPS-based position; monitor position reports from other participants; stimulate participant's sensors with targets, threats, and EW; evaluate any weapon employment events; and provide feedback to the participant. JTCTS simulation/stimulation does not preclude the participants actual onboard sensors from acquiring real targets.

JTCTS will be able to track 130 participants (100 aircraft, 24 ships, and 6 submarines) over a 400 nautical mile radius area. JTCTS will include all principle USN/USAF/USMC tactical platforms. Through distributed processing and scenario generation and control, JTCTS will seamlessly merge virtual and real targets.

JTCTS open architecture design, standards compliance, and DIS compatibility will permit future expansion and interoperability. JTCTS has the potential to interface with instrumented ground forces and have connectivity with land-based simulators, mission planning/rehearsal systems, and wargames software.

Related Projects and Activities. OSD intervention resulted in a joint program that will meet the needs of the Marine Corps, Navy, and the Air Force. JTCTS will support training at sea and at current fixed and fleet ranges. The Air Force will also produce a transportable variant that will be used to support contingency training at locations world-wide.

Platform Requirements. TBD.

Current Status of the Project. The JTCTS request for proposal (RFP) was released to industry on 8 September 1994. Contract award is on track for February 1995. A Joint Program Office (JPO) will be established after the contract award.

Project Schedule. Milestone II was accomplished in January 1995. The Engineering and Manufacturing Development (E&MD) contract is scheduled for award in February 1995. Initial Operating Capability (IOC) for MCAS Cherry Point is FY00, MCAS Yuma in FY01, and MCAS Beaufort in FY04.

Appendix A.10

LeatherNet

Purpose. ARPA is participating in the LeatherNet Project to develop the capability for tens of thousands of entities (from live, virtual and constructive simulations) to interact in a synthetic environment. The ARPA work at the Marine Corps Air Ground Combat Center (MCAGCC) is in preparation for a large Distributed Simulation Internet (DSI) exercise in 1997, called the Synthetic Theater Of War-97 (STOW-97). A primary concern of this project is creating Semi-Automated Forces (SAF) that depict infantry behavior accurately.

Marine Corps participation in LeatherNet offers many advantages. As a result of this project, ARPA will expend \$11M to \$14M dollars developing the SAF and integrating these constructive infantry models with high resolution elevation information. At the end of the program, the Marine Corps will have a DIS-compatible tool that integrates live, virtual and constructive simulations.

Approach. The work on LeatherNet is in three primary areas: (1) terrain, (2) infantrymen (SAF), and (3) display capability. To adequately reflect infantry behavior, very accurate computer models of the terrain are necessary. ARPA elicited the help of the Army Topographic Engineering Command to develop a model of Range 400. The terrain programmers are working closely with the SAF programmers so the infantry interacts correctly with the terrain. Development of the terrain is an iterative process. This work also tests the integration of high resolution elevation information with standard Defense Mapping Agency (DMA) computerized products. Once the terrain of Range 400 is suitably modeled, work will begin on the Delta Corridor.

Locating the SAF programmers at the LeatherNet facility provides them with real life models of infantry in action and access to subject matter experts. Marines and programmers participate in an iterative development process, ensuring that the SAF will perform appropriately. A key behavior for

SAF to display is the use of cover and concealment in route selection. Future work will concentrate on capturing the commands of the five paragraph order from the commander. The ability of large screen and helmet mounted displays to project the synthetic environment in controlled conditions is well developed. The representation of the SAF on the display requires additional work. Currently, SAF look like "Lego™ men."

The LeatherNet project gives the Marine Corps the ability to exercise any size MAGTF, from geographically dispersed locations. With this capability, commanders may test their battle plans over the actual terrain of Twentynine Palms. In this way the Marine Corps can train more units (due to the lower cost of the Computer-Assisted Combined Arms Exercise (CCAX) conducted in the synthetic environment) or offer more effective training to units conducting an actual CAX. The LeatherNet is a tool to validate doctrine and tactics. The Marine Corps can analyze current or future warfighting concepts against an array of threats. Marine Corps participation in LeatherNet leverages ARPA dollars in a very cost-effective manner. For the expenditure of \$600K, the Marine Corps gains the ability to actively participate in Advanced Distributed Simulations (ADS).

Related Projects and Activities. The Army is fielding the Battlefield Distributed Simulation - Developmental (BDS-D) in an effort to achieve a similar set of capabilities. Further, STRICOM has issued a Broad Agency Announcement (BAA) seeking development of networked battlefield simulation technology, computer generated forces and a general linkage of simulators & simulations. The bulk of these requirements are addressed by LeatherNet.

Platform Requirements. The LeatherNet Lab (interim facility) in Building 1553 has one Silicon Graphics® Onyx machine, two Silicon Graphics® Crimson and four Indigo reality computers. These machines execute the USMC SAF software developed by Hughes. The SAF software is based on ModSAF v1.2.

Current Status of the Project. Work on LeatherNet currently focuses on the Range 400 digitization effort and refinement of the SAF. An Initial Program Review (IPR) was completed successfully in December 1994.

Project Schedule. Work on LeatherNet began during FY94, involving ARPA, MITRE, Hughes and the Army Topographic Engineering Command. The initial goal is to develop a synthetic environment which accurately portrays Range 400. An IOC is anticipated by the end of FY95. Complete construction of the permanent facility to house LeatherNet is projected for February 1996. The goal for the end of FY97 is the simulation of a combined arms attack through the Delta Corridor.

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Appendix A.11

MCTFIST

Purpose. The Marine Corps Tank Full-Crew Interactive Simulator Trainer (MCTFIST) is a Marine Corps Reserve deployable appended tank simulator that enables crew members to train as an integral unit using the actual vehicle in which they will fight.

Approach. Computer Sciences Corporation (CSC) pioneered the FIST concept, demonstrating the first appended device in 1986. Four generations of FISTs have been developed since then, with the latest design for the M1A1 main battle tank. MCTFIST is an element of CSC's Armor-FIST (A-FIST) family of appended full-crew gunnery skills trainer. A MCTFIST simulator for the M60A1 was employed aboard the USS Mount Vernon and USS Tarawa during Operations Desert Shield/Desert Storm. The current MCTFIST (M1A1) will be replaced by the fielding of the CVAT. Only one M1A1 MCTFIST has been fielded.

Related Projects and Activities. CVAT and the DTT ATD are ongoing efforts that parallel MCTFIST.

Platform Requirements. Capable of operating on standard power, portable generator, or ship power; does not require any special facility. Operates at temperature range of 32-110 degrees Fahrenheit.

Current Status of the Project. One modified system (M60 to M1A1) is deployed with Company B, 4th Tank Battalion.

Project Schedule. TBD.

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Appendix A.12

MTWS

Purpose. The MAGTF Tactical Warfare Simulation (MTWS) is a computer-assisted tactical command and control training system that provides the MAGTF commander and his staff with a realistic combat environment for them to plan and conduct exercises involving ground, air, and amphibious operations. It is designed to support field exercises involving combat units, command post exercises with staffs, and exercises involving combinations of live and simulated units. MTWS is being developed as the Marine Corps replacement for the Tactical Warfare Simulation Evaluation and Analysis System (TWSEAS).

Approach. The intent is to field a deployable system for advanced tactical-combat and aggregate level simulations that will serve as a decision support tool. The hardware architecture is designed to be open and distributed; the software incorporates object-based programming; the system is interactive, allowing multi-sided/force-on-force wargaming and near-real time simulation participation. MTWS is intended to interoperate with the Position Location Reporting System (PLRS).

Related Projects and Activities TBD.

Platform Requirements For application network and local system control functions, reduced instruction set computers (RISC) with 192 MB RAM and 1.3 GB Disk storage are required. For remote system control and individual workstations, RISCs with 96 MB RAM and 1.3 GB disk storage are necessary.

Current Status of the Project. Developmental testing was conducted in November 1994. System hardware has been positioned at each of the MTWS sites.

Project Schedule MTWS is scheduled for Operational Acceptance/MS III in May 1995.

Appendix A.13

TAMPS

Purpose. The Tactical Aircraft Mission Planning System (TAMPS) is designed to prepare Navy and Marine Corps aircrews for successful mission performance in the Joint arena. TAMPS is an interactive computer graphics system supporting aircrew-oriented planning for true aircraft and weapon systems integration. It is used to develop, analyze, store and download mission data to strike aircraft, assault aircraft, support aircraft, standoff or precision-guided munitions and selected avionics equipment. Designed as a migration system, TAMPS has been designated as the Mission Planning System for the Navy and the Marine Corps.

Approach. TAMPS automates critical en route and terminal planning in support of multi-sortie missions, as well as single aircraft or weapons. Stemming from lessons learned in Desert Storm, the aircrew-designed graphics provide simple and fast planning and preview capabilities. The tactical mapping system provides a full 3-D mission preview capability. Aircrews can practice their missions, taking into account approach paths, terrain data, threats, weather and target locations. TAMPS directly uses DMA charts and imagery products, and cartographic data from other sources. TAMPS provides an evolutionary capability that can be upgraded to support force-level, as well as unit-level planning. TAMPS (version 6) has an Open Systems Architecture using:

- Aircrew-designed, fully integrated displays.
- A relational DBMS (object oriented).
- A tactical mapping system providing a 3-D mission preview, with an imagery tool set.

- Communications processor.
- COTS software (e.g., Solaris, HP/UX, Sybase, MOTIF).
- Fully integrated GOTS applications.
- Intelligence server for deployed units.
- Minimized mission planning module (MPM) impact.
- Native DMA products.
- Scaleable, flexible Core System.
- Spatial database.

Related Projects and Activities. TAMPS is interoperable with the following systems: JMCIS (Maritime); TERPES/TEAMS/IAS (USMC); TSCM (Force-level); CTAPS/AFMSS (USAF); and GPS (USCG).

System Specific Equipment Requirements. TAMPS will run on a wide variety of UNIX-based workstations, with the HP Model 755 as one representative example.

Current Status of the Project. TAMPS is available as an OTS system. It has been used to fully prepare Navy and Marine Corps aircrews for successful mission performance in the joint arena. Close liaison with the Marine Corps is being maintained to ensure its requirements are being met.

The total USMC requirement for the Operational Requirements Document (ORD) is 449 workstations. Procurement is fully funded in the POM-96 FYDB.

Project Schedule. TAMPS is an operational software system now in release 5.x, with version 6.0 to be released in June 1995.

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Appendix A.14

TTES

Purpose. The Team Target Engagement Simulator (TTES) is a Marine Corps-sponsored science and technology (S&T) project which is intended to develop the core virtual reality technology to enable realistic Military Operations in Urban Terrain (MOUT) training for individual combatants and small units in deployed and expeditionary settings. The primary focus of the effort is on general purpose infantry, special operations, security forces, and rear area security.

A key potential of TTES is the transition from training to mission preview and rehearsal. While in mission rehearsal, individual combatants will actually practice the mission in a simulated objective area corresponding to the planned mission, against computer controlled hostiles (CCHs).

The technology objective is to develop a Dynamic Synthetic Environment (DSE) which will enable realistic small unit force-on-force training. The two DSE components, behavioral and environmental representation, will synergistically combine to form the fidelity and high resolution setting required for effective individual combat training in a synthetic environment. The current configuration for TTES was established as an evaluation suite for the DSE effort.

Approach. In FY93 the TTES Advanced Technology Demonstration (ATD) (6.3a effort) was initiated and will continue through FY96. This pioneering effort is part of the Marine Corps-wide effort to apply advanced modeling and simulation capabilities to individual combatants. An urban focus for the synthetic environment was chosen due to mission relevance and to sufficiently challenge the evolution of technology. Close combat

marksmanship and tactical decision-making skills are the training aspects initially emphasized; TTES is intended as the next-generation small arms trainer to replace the Indoor Simulated Marksmanship Trainer (ISMT) in the year 2002. The TTES will provide a 3-D, fully digital terrain and digital threat representation that will replace the laser-disk technology used with ISMT. Eventually, through the use of DIS, training will be optimized for small teams through the networking of multiple deployed TTES stations to form a unit fighting the same CCHs. The exercising of tactical decision making skills will be the most beneficial capability of TTES.

This effort is coordinated directly with the US Army Infantry School, the ARI, and STRICOM. NAWCTSD is responsible for technical management and system design and integration; other participants include the IST — computer-controlled hostiles/neutrals, and dynamic environments; Boston Dynamics Inc. and the University of Pennsylvania — human icon/figure graphics; Integrated Sensors Inc. — weapon and body-part tracking; Southwest Research Institute — instructional shell; Waterway Experimentation Station (WES) — dynamic environmental effects; Naval Postgraduate School — combat behavior analysis; and TEC and Paradigm Simulation Inc. — micro-terrain databases/mapping.

Related Projects and Activities. Joint participation is with the Air Force, ARI and ARL in the DMSO-sponsored Individual Combatant Simulation System (ICSS) for behavioral representation and human interface. Environmental representation participation and coordination is achieved via the DMSO-sponsored Dynamic Environmental Effects Model (DEEM). TTES technology can feed two follow-on concept ATDs, the Deployable Crew-Served Weapons Trainer (DCSWT) and the Small Unit Rehearsal Environment (SURE).

Other efforts related to TTES are sponsored by the Army Infantry School, involving the Dismounted Battlespace Battle Lab, I-Port and the Individual Combatant Simulation Center.

ARPA is involved in STOW 97, which involves developing a detailed terrain database of Range 400 at Twentynine Palms.

Platform Requirements. The evaluation suite configuration consists of a large rear-display screen (70 x 50 degrees field of view) located six feet from the trainee, who is equipped with a weapon (currently an M16A2), a foot pedal (14" x 8") for movement through the terrain, and a head tracker (Ascension Technology's Bird). A three dimensional model of Quantico Combat Training Village is currently being used. The host platform for the visual system is a Silicon Graphics computer.

The configuration envisioned for Year 2002 consists of non-tethered tracking emitters to monitor human movement; head-mounted visual/audio display; trainee computer pack; weapon and body monitors; a foot-controlled movement device; and a master computer with short range radio networks.

Current Status of the Project. The baseline work is on schedule; the scope of the effort will be expanded relative to the available funding.

Project Schedule. A system upgrade is scheduled for 2nd Quarter FY95; the Comparative Assessment II is scheduled for 3rd Quarter, FY95. 6.4 effort is projected to start in FY97 through MS II at the end of FY98.

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Appendix A.15

TOPSCENE

Purpose. The Tactical Operational Preview Scene (TOPSCENE), a "deployable system," prepares Joint Service weapons launch crews/platforms (shooters) for successful missions. This interactive imagery based mission preview system provides for actual mission preview for weapons employment and operational flight missions. It enables fixed wing and rotary wing aviators, ground troops and special operations personnel (Navy, Army, Air Force, and Marines) to fly-over/travel over designated areas of potential and current military activity for orientation, high altitude target runs and to obtain a ground-level visual perspective.

Approach. TOPSCENE combines both a database generation capability and a mission preview capability in a single deployable system (occupies 1.5 ship-board racks) that provides imagery to support deployed personnel. These units, located at shore based and shipboard sites world-wide, provide crew members mission preview at altitudes from ground level up to 20,000 feet and speeds from 0 knots to 600 knots. As "hot spots" emerge, processing and imagery acquisition are dedicated to produce a data base produced for the area of interest. Once prepared, the information is stored on portable video disk platters, optical disks, and various tape media prior to transfer to the deployable preview device.

Mission preview allows crew-members to practice their missions, taking into account threats (AOB/EOB), targets, flight routes (terrain data) and limited weather. Mission preview is performed at the operator station using a throttle, control stick and high resolution monitor.

Program controls are provided via a simple keypad interface. Keypad entries select the contingency area of operations, initial position parameters and mission profile. Navigation

and flight control information is graphically overlaid on the out-the-window scene to provide the heads-up-display (HUD). Keypad entries enable the operator to stop the scenario and analyze the scene at any time or to replay the scenario from the start.

TOPSCENE satisfies operational needs of aircrew members, battle managers, and strike planners for timely, high-fidelity imagery available in an environment that allows real-time, mission-specific preview of contingency operations. TOPSCENE has an open systems architecture using:

- Database generation systems.
 - Located and operated in SCIFs
 - Process and receive national asset information
 - Imagery updates/archive imagery (can provide real/derived/simulated imagery)
 - All source data
 - Data fusion
- Freeplay flight within contingency area.
- Terrain image mapping system and recording/geometry algorithms providing 3-D mission preview (out-the-window heads-up display).
- Provides ability to view missions.
 - Avoid threats
 - View target areas and ingress/egress routes
 - Identify navigation/aim points
 - Evaluate terrain masking
- Guided weapon end game training.
- Hard drives and portable media transferred to deployable preview devices are classified SECRET/NOFORN/WININTEL.
 - Required for terrain and culture imagery stored on these media

- Generic aircraft flight model designed for database viewing/preview and not to model a particular airframe.
 - Hover can be achieved anywhere to look at database features
- Host system for the ONYX computer is IRIX; a UNIX derivative (Version 5.2).
- Software is written in ANSI C and FORTRAN 7.
 - COTS, GOTS, and custom written code
- Government property rights to system software (no software licenses required beyond normal user licenses for COTS).
- Government owned production system.
 - Supported by government technical representatives
 - Spares and maintenance available
 - Self-sustaining and limited training (1 hour) required
- Cultural feature image processing algorithms.
- Horizontal Datum - WGS-84; Vertical Datum - MSL.
- Fully functioning production facility in place.

Related Projects and Activities. The ONYX computer offers Ethernet communications via TCP/IP, DECnet, and other network protocols, serial communication via RS-232 and RS-422 and parallel communication. Obtains OB/BLENT externally through TAMPS.

System Specific Requirements. As of FY95, TOPSCENE requires 1.5 racks of shipboard space. System requirements include a Polygon Generator (for 3-D Terrain Polygon Generator), CRT monitor, imagery data disks (33 gigabytes on each side of optical platter-RGB RS-170-A format), and 1/4 inch tape (5 gigabytes). An Ethernet communication channel is available to provide an interface to other systems, however, communication link software is required for the interface. Electrical requirement include two NEMA type 5-20R electrical outlets, with each outlet supplying 20 amps, 120 volt single phase power.

Environmental conditions should be in the temperature range of 15° to 30° C (operating) or - 10° to 50° C (non-operating/storage) and a humidity range of 20-80% relative humidity, no condensation (storage - 5-90% relative humidity, no condensation). The windowing environment, if any, uses X-Windows Version IIRS with Motif 1.2.3.

Current Status of the Project. TOPSCENE is currently operational. The Navy has three operational units assigned to Carrier Battle Groups (CVBG) and one unit assigned to Naval Strike Warfare Center. The Marine Corps has one operational unit assigned to 2nd Marine Aircraft Wing (MAW) which is Forward Deployed with the Marine Expeditionary Unit (MEU) Air Combat Element (ACE). Army special operations has purchased two units and the Air Force has purchased nine units. The total requirement for the Navy is for 25 deployable units, 13 of which will be allocated to Marine Aircraft Wings. The specific distribution plan is in accordance with CMC 130003Z Sep 94 message. Planned 1995 deliveries include one system each for 1st and 3rd MAW.

Project Schedule. TOPSCENE is in a pre-planned product improvement state for mission rehearsal. The Mission Rehearsal phase is scheduled for completion in FY-98. It will provide, at the least, interactive threats and incorporate imagery updates, meteorological information, sensor inputs, specific threat information, and weapons characteristics.

Appendix B

Leveragable M&S Programs

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Note that inclusion of a commercial product in this Appendix in no way implies either an endorsement or a recommendation by the Marine Corps to purchase the product, or that it has been judged "better" in some sense than any other comparable product.

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Appendix B.1

Introduction

This appendix describes a sample of some of the current and planned modeling and simulation (M&S) efforts that might be leveraged by the Marine Corps to satisfy specific needs. In researching the many M&S cases that might be applied to Marine Corps needs, it was found that the Defense Modeling & Simulation Office (DMSO) on-line catalog of M&S tools lists over 1,300¹ potentially useful capabilities. Needless to say, the schedule for preparation of this initial version of the Marine Corps' M&S Investment Strategy left little time to spare to examine each of these, plus the many others not listed there. Instead, it was decided that a representative sample of the programs (existing or being developed) that might be applied to Marine Corps needs would be presented here in abbreviated form. When more time is available the many other cases will be considered and the Investment Strategy will be updated accordingly.

Table B-1 identifies and summarizes these representative programs which may have applicability to Marine Corps needs. The remainder of this appendix provides additional information on these representative efforts which include, where data are available, the following: (1) purpose of the program, (2) approach being taken, (3) platform requirements, (4) related projects and activities, (5) current status of the project, and (6) project schedule. These descriptions are presented in alphabetical order. Note that complete data sets were not available for all of the projects at the time of the Investment Strategy's first printing; hence, the missing information is labeled "TBD"² for the present.

¹ The DMSO M&S catalogs contain approximately 300 Army projects, 300 Navy projects, 500 J-8 projects, 50 RADC projects, 100 TRANSCOM projects, and 100 "other" projects. Air Force project catalogs were not accessed during this study.

² To Be Determined (TBD).

Table B-1. Summary of Sample of Programs Applicable to Marine Corps Needs

Program	Purpose	M&S Class ³	Costs	Point of Contact
BDS-D	Battlefield Distributed System Demonstration is an accredited, real-time simulation of the joint and combined battlefield.	TBD	<u>Software</u> : TBD <u>Hardware</u> : Needs unspecified at present.	Mr. Gene Wiehagen STRICOM Voice: (407) 380-8077
BLRSI	Battle Lab Reconfigurable Simulator Initiative (BLRSI) will design and field easily reconfigurable robust and versatile simulators.	CM, RBR, RPER, SE, SG, SM	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : Needs unspecified at present.	MAJ John Norwood, PhD HQ, TRADOC Fort Monroe, VA Voice: DSN: 680-2868 (804) 727-2868 Fax: (804) 727-2947
CATT	Combined Arms Tactical Trainer (CATT) creates a surrogate wargaming world in which simulators are used as a means of waging unconstrained warfare.	CM, RBR, RPER, SE, SM	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : Needs unspecified at present.	Col James E. Shiflett STRICOM Voice: (407) 384-3210
COMPASS	Common Operational Modeling, Planning And Simulation System (COMPASS) integrates distributed planning and rehearsal capabilities in legacy planning systems.	M&S Integration Tool	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : No additional hardware required.	LtCol G. Flemings Defense Nuclear Agency Alexandria, VA Voice: DSN: 221-2073 (703) 325-2073 Fax: (703) 325-2964
COMPU-SCENE	Family of image generators for interactive simulations.	RPER, RPRS	<u>Software</u> : Contact vendor. <u>Hardware</u> : Need UNIX-based system.	Mr. Steve Buzzard Martin Marietta Orlando, FL Voice: (407) 826-1710
FAMSIM	The Family of Simulations (FAMSIM) includes all combined arms simulations and computer simulations.	CM, RBR, RPER, SE, SM	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : Needs unspecified at present.	Mr. Simons STRICOM Voice: (407) 384-3222
FLAMES™	Force Level Analysis & Mission Effectiveness System (FLAMES™) will provide an M&S configuration representing military systems and human behaviors in an interactive environment.	CM, RBR, RPRS, PRER, SE, SG,	<u>Software</u> : \$10K to \$75K depending on options. 15% Annual maintenance cost <u>Hardware</u> : Need UNIX-based system.	Mr. Brad Spearing Ternion Corporation Huntsville, AL Voice: (205) 881-9933 Fax: (205) 881-9957
GT200	High quality real-time image generation for networked simulations.	RPER, RPRS	<u>Software</u> : Contact vendor. <u>Hardware</u> : Contact vendor.	Mr. Marion Hauck Loral ADS Bellevue, WA Voice: (617) 441-2000 Fax: (617) 441-2069

³ The M&S Capability Classes are discussed in detail in Appendix C.

Table B-1. Summary of Sample of Programs Applicable to Marine Corps Needs (Continued)

Program	Purpose	M&S Class	Costs	Point of Contact
ITEM	The Integrated Theater Engagement Model (ITEM) provides air, land, and naval warfare engagement modules in theater level campaigns.	TBD	<u>Software</u> : None at present. User fee probable. <u>Hardware</u> : TBD.	LtCol D. Tehee 6801 Telegraph Road Alexandria, VA 22310-3398 Voice: (703) 325-1140
MARS	The Multi-Warfare Assessment and Research System (MARS) simulation system provides a battle force level Monte Carlo model of naval multi-warfare battle engagements.	TBD	<u>Software</u> : MODSIM, CLIPS. <u>Hardware</u> : Sun, VAX,SGI, HP, PC, Mac II.	Dr. Henry C. Ng NSWC White Oak Lab Voice: (301) 394-3732 A/V 290-3732
NSS	The Naval Simulation System (NSS) program will develop a family of models functioning within a single framework. Open architecture; object-oriented design.	TBD	<u>Software</u> : TBD. <u>Hardware</u> : TBD.	Mr. Greg Melcher SPAWAR 31 Voice: (703) 602-0911
RASPUTIN	Rapid Scenario Preparation Unit for Intelligence (RASPUTIN) is a map-based visual scenario generation tool.	CM, RBR, RPER, RPRS, SG	<u>Software</u> : \$10K to \$75K depending on options. 15% Annual maintenance cost <u>Hardware</u> : Need UNIX-based system.	Mr. Mark Raker MRJ, Inc. McLean, VA Voice: (703) 277-1859 Fax: (703) 385-4637
SEE	The Synthetic Exercise Environment (SEE) is a DIS-compatible database for a fictional world. SEE supports computer-based planning, modeling, simulations and exercises in an apolitical, but operationally realistic, environment.	CM, RBR, RPER	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : UNIX-based system (e.g., UNIX HP 700 series or Sun SPARX2) required.	Lt Col Duane Tehee Defense Nuclear Agency 6801 Telegraph Road Alexandria, VA 22310-3398 Voice: DSN: 221-1140 (703) 325-1140
STAGE™	Scenario Toolkit and Generation Environment (STAGE™) is a workstation software system for designing synthetic environments without programming.	CM, RBR, RPER, RPRS, SE, SG, SM	<u>Software</u> cost in range of \$15K to \$100K. 15% Annual maintenance cost. <u>Hardware</u> : Need UNIX-based system.	Mr. Scott Simmons Virtual Prototypes, Inc. Carlsbad, CA Voice: (619) 931-4707 Fax: (619) 929-9669

Table B-1. Summary of Sample of Programs Applicable to Marine Corps Needs (Concluded)

Program	Purpose	M&S Class	Costs	Point of Contact
VAST	Vulnerability Analysis for Surface Targets (VAST) is a point burst methodology used to estimate vulnerability of surface targets.	CM, RPER, RPRS	<u>Software</u> : Fortran <u>Hardware</u> : CRAY XM-P under UNICOS operating system.	L.D. Losie Ballistic Research Lab Aberdeen Proving Ground, MD 21005-5066 Voice: (301) 272-6979 A/V 298-6979
VIT	Virtual Interactive Target (VIT) provides a DIS compatible interactive target.	CM, RBR, RPER, RPRS	<u>Software</u> : No cost -- Government owned. <u>Hardware</u> : Currently running on two networked Silicon Graphics® workstations.	LCDR Kay DiNova, USN DNA, Wpns Effects Div. 6801 Telegraph Road Alexandria, VA 22310-3398 Voice: (703) 325-5421

Legend For Figure B-1.

ABBREVIATION	DEFINITION	ABBREVIATION	DEFINITION
CM	Constructive Models	RPRS	Realistic Physical Representations of Systems
IS	Instrumented Systems	SE	Simulation Engine
RBR	Realistic Behavioral Representations	SG	Scenario Generator
RPER	Realistic Physical Environmental Representations	SM	Simulators

Appendix B.2

BDS-D

Purpose. The Battlefield Distributed Simulation - Demonstration (BDS-D) is one of a number of significant M&S programs under the cognizance of the Simulation, Training, and Instrumentation Command (STRICOM⁴). The mission of STRICOM includes the following:

- Technology base for simulation and training
- Acquisition of training devices/simulators/simulations, instrumentation, targets, and threat simulators
- Life cycle sustainment support of fielded products
- Serve as the DOD focal point for the DIS environment and the Aggregate Level Simulation Protocol (ALSP)
- Operate aerial and ground targets for test and training
- Quality support to the warfighter

As noted in the STRICOM pamphlet, the BDS-D system is an accredited, real-time simulation of the joint and combined battlefield. It is the Army's networked simulation testbed, serving as a laboratory showcase used to evaluate new design concepts, with the warfighter-in-the-loop. It will support materiel development, combat development, and operational testing by providing a cost effective alternative to proof-of-principle demonstrations, field tests, and operational evaluations in all phases of force development.

Approach. The program addresses interoperability of systems including simulations for command and control, simulators for weapon systems, actual operational systems, and Computer Generated

⁴ US Army.

Forces (CGF). An open system design architecture, with a common set of protocols and standards to achieve interoperability of simulations will be the primary focus of the program development.

The BDS-D will also provide a mechanism to continue research and development of networked distributed simulations and simulators for use in supporting contingency planning; in developing and testing doctrine and organization; in training and leadership development; in development of materiel concepts and requirements; and in designing field tests. The BDS-D system will provide the Army with a DIS capability linking government, university, and industry sites.

STRICOM has the responsibility for maintaining a technology base for simulation, training devices and instrumentation. Coordinated efforts with the Navy, Air Force, and the Marine Corps to develop sources of technology while avoiding duplication of effort and maximizing the use of resources available in laboratories of other government agencies, universities and industry.

Related Products and Activities. The technology base addressed by the BDS-D program includes, for example, the following technology areas:

- Networked battlefield distributed simulation;
- Speech recognition and speech synthesis;
- Computer generated forces and semi automated forces (SAFOR);
- General linkage of simulations/simulators;
- Dismounted infantry integration; and
- Combat training centers/tactical engagement simulations (CTS/TES).

Platform Requirements. No hardware or software specified at the present time.

Current Status of the Project. The BDS-D program is funded and budgeted.

Project Schedule. The current schedule for BDS-D is shown below in Figure B-1.

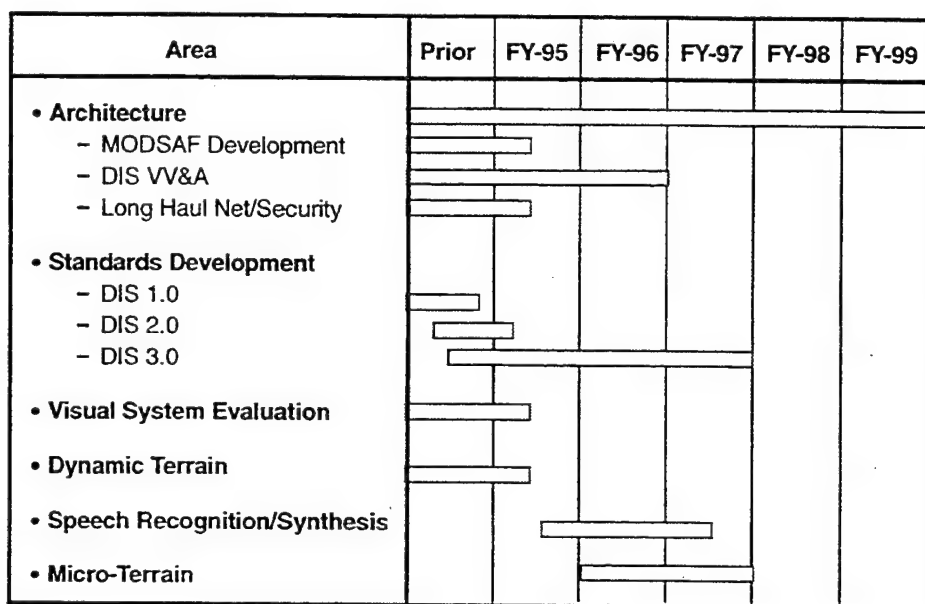


Figure B-1. STRICOM/BDS-D Schedule

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Appendix B.3

BLRSI

Purpose. The Battle Lab Reconfigurable Simulator Initiative (BLRSI), under the cognizance of the US Army Training and Doctrine Command (TRADOC), will design, and ultimately field, a new generation of robust, versatile simulators that are easily reconfigurable in terms of both hardware and software. It will provide a significant increase in software fidelity for experimentation with new concepts, technologies, and systems for Force XXI. BLRSI will provide a tool kit for concept analysis and utility testing. It will also permit exploration by military staff of areas of system specification uncertainty. In terms of Marine Corps usage, the BLRSI will provide a means whereby Marine Corps concepts can be examined in more detail, thereby clarifying system requirements and reducing procurement costs by minimizing false starts and vague specifications.

Approach. Initial efforts will focus on generic simulator prototype developments which will expand the understanding of simulator requirements, including both hardware (processors, networks, Man Machine Interface (MMI) displays) and software (object oriented, distributed, reusable, adaptable). These prototypes will, through early experimentation, provide an analytical base upon which can be built (assembled) generic simulators for a variety of applications in analysis, training, and decision making tasks. Emphasis during this effort will be on leveraging on-going work and maintaining a broad, long term vision of the value of reconfigurable simulators and its various users. This effort will result in: (1) early prototype development of generic simulators and components, (2) requirements specification which can be used to procure reconfigurable simulators, and (3) better understanding of the need for and composition of reconfigurable simulators.

Reconfigurable simulators (RSIMs) are needed for a wide range of simulated warfighting, including mounted infantry, dismounted infantry (group and individual warrior), fire support, battle command (battle vehicles and missile/cannon systems), engineering support, aviation, combat support, and air

defense. Each of these areas will be addressed in terms of general needs, current simulation software, and existing hardware availability. Marine Corps participation in the BLRSI effort will ensure parochial interests are adequately addressed during prototype development and requirements preparation. This can be accomplished at minimal costs (vice complete Marine Corps funding).

Related Projects and Activities. Current efforts, such as Joint Simulation System (JSIMS), Naval Simulation System (NSS), and Warfighters' Simulation (WARSIM) 2000 focus on a different aspect of the common problem; that is, on the elements needed for a distributed and interactive simulation capability. The other side of the generic coin is the need for a rapid assessment of new user interfaces to warfighting systems. The latter is addressed by the BLRSI.

Platform Requirements. At this point in time no specific equipment has been identified for this Program. The initial effort by TRADOC, and its support contractors, will identify system characteristics needed for the BLRSI to be included in a subsequent system development procurement.

Current Status of the Project. Preliminary efforts have just begun with initial funding in FY95 for start-up work. The BLRSI support contract was awarded in October 1994; it involves three contractors: (1) Veda, (2) CAE-Link, and (3) Martin Marietta. The initial goal will be the development of RSIM functional requirements and the preparation of an RFP specification. By FY96 it is anticipated that five RSIM prototypes will have been developed for specific use by the community.

Project Schedule. The approved BLRSI development schedule extends out to FY01, with early prototypes expected in FY96/97. Initial capabilities should be available sometime in FY98 or later.

Appendix B.4

CATT

Purpose . STRICOM's Combined Arms Tactical Trainer (CATT) is a group of fully interactive networked simulators and command, control and communications workstations, replicating the vehicles and weapons systems of a company/team and its supporting combat, combat support, and combat service support elements, operating on a simulated real-time battlefield. The following capabilities will be produced under the CATT effort:

- Air Defense Combined Arms Tactical Trainer (ADCATT) - allows short range Air Defense (SHORAD) units to train collective tasks associated with the support of Mechanized and Armor Maneuver units;
- Aviation Combined Arms Tactical Trainer (AVCATT) - allows attack helicopter and air cavalry units to conduct tactical maneuver training;
- Close Combat Tactical Trainer (CCTT) - allows mechanized infantry and armor units to conduct tactical maneuver training;
- Engineer Combined Arms Tactical Trainer (ENCATT) - allows engineer units to train collective tasks associated with command and control, mobility, countermobility and survivability on a simulated interactive battlefield; and
- Fire Support Combined Arms Tactical Trainer (FSCATT) - provides combined arms collective training of field artillery units. Specifically, it provides training of the field artillery gunnery team (forward observer, fire direction, and firing battery personnel), providing them feedback on their proficiency while conserving fuel and ammunition.

The initial CATT effort is development of the Close Combat Tactical Trainer. Follow-on programs include the Aviation Combined Arms Tactical Trainer, the Air Defense Combined Arms Tactical

Trainer, the Engineer Combined Arms Tactical Trainer, and the Fire Support Combined Arms Tactical Trainer, Phase II.

The CATT's Close Combat Tactical Trainers features include networked man-in-the-loop modules; distributed processing; visual based battlefield; combined arms/collective training; force-on-force free play simulation; comprehensive after action review; and fixed site and mobile versions.

Approach. The CATT family creates a surrogate wargaming world in which simulators are used as a means of waging unconstrained warfare. They will provide a "combat area" in which combatants can engage in actual warfare without having to consider peacetime safety, environmental or terrain restrictions. Each crew member of the simulated weapon systems provides "man-in-the-loop" intervention into the battle

Related Programs and Activities. The Battlefield Distributed Simulation - Developmental (BDS-D) technology base program will provide technology insertions to support an accredited warfighter-in-the-loop, real-time, distributed simulation of a virtual combined arms battlefield.

Platform Requirements. TBD.

Current Status of the Program. Portions of the CATT family of trainers are funded, budgeted and are under development at the present time.

Program Schedule. The current CATT development and production program schedule is given in Table B-2 below.

Table B-2. The CATT Schedule

PROGRAM	FY95		FY96		FY97		FY98		FY99	
	Devel	Prod	Devel	Prod	Devel	Prod	Devel	Prod	Devel	Prod
ADCATT							X		X	
AVCATT			X		X		X		X	
CCTT	X		X		X	X		X		X
ENCATT									⇒	
FSCATT									⇒	

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Appendix B.5

COMPASS

Purpose. The Common Operational Modeling, Planning and Simulation System (COMPASS) implements an innovative strategy to integrate distributed collaborative planning and rehearsal capabilities in legacy planning systems. A network of "COMPASS-capable" legacy systems allows geographically dispersed planners to use their current applications to exchange, review, and modify mission planning information and modeling/simulation results in an interactive, real-time, "virtual conference room" environment.

COMPASS is a joint Defense Modeling and Simulation Office (DMSO), Defense Nuclear Agency (DNA), and Advanced Research Projects Agency (ARPA) program.

Approach. COMPASS is a software add-in and an operational standard method for interfacing similar software capabilities. For example, TAMPS provides a mission planning capability, as does the USAF's AFMSS. By adding in the COMPASS software to TAMPS it is possible to share on-line mission planning, performance and effectiveness data by both systems, thereby producing a more integrated plan for a joint mission.

The COMPASS Program intention is to develop software that can accomplish this integration and make it a standard. In practice, the procedure has been to have DNA work through their contractor, Science Applications International Corporation (SAIC), located in McLean, Virginia, who in turn would work with the "new" software developer (e.g., Ternion Corporation for FLAMES™) to add in extensions to PDUs to ensure compliance with COMPASS requirements. This way the software will undergo VV&A in the process of installing COMPASS routines. Where new software procedures become necessary to accommodate the COMPASS needs, these will be documented and added to the

COMPASS Interface Control Document (ICD) as an appendix so that others will not have to go over covered ground.

Related Projects and Activities. The Joint Maritime Command Information System (JMCIS) and the Collaborative Mission Planning System (CMPS) will provide software and implementation strategies and concepts for use of COMPASS in NSS. TAMPS has already been COMPASS-modified and accredited for use; AFMSS will have its COMPASS modifications completed by the summer of 1995. The Integrated Tactical Environment Modeling System (ITEMS), REAL WARRIOR (Europe), and Tomahawk systems will be COMPASS-compliant in the near future also.

Platform Requirements. COMPASS involves software only in most cases. Generally, no additional hardware is required to implement the COMPASS capability, since most of the DIS systems will already have adequate communications equipment installed.

Current Status of the Project. As noted earlier, COMPASS is operational on a number of systems and will evolve as new support programs are made COMPASS compliant.

Project Schedule. The COMPASS software is mature and is only changing in an evolutionary manner. Emphasis at this point is to ensure that COMPASS installations are compliant with the latest ICD.

Appendix B.6

Compu-Scene

Purpose. Compu-Scene is a family of high performance, real time image generators used with interactive simulations and training that was developed by the Martin Marietta Information Systems Company. Products in this line deliver a synthetic environment derived from an array of sources, and various levels of fidelity can be specified. Compu-Scene visual systems are used in armor, helicopter and fixed wing trainers, and they provide high value training in tactical environments and flight simulators, including radar trainers, part task trainers, and full mission rehearsal.

Approach. From virtual reality applications to high fidelity weapons system training and mission rehearsal, the visual system must deliver the desired level of fidelity to be able to derive synthetic environments from a variety of available sources. Compu-Scene uses an environment database workstation called the Training and Rehearsal Generation Toolkit (TARGET) to synthesize a variety of data sources. TARGET correlates the data sources so that out-of-the-window images and sensor images (e.g., radar screens) match up correctly. The fidelity of the out-of-the-window image display depends on the system selected. Likewise, system size depends on the user needs.

Keeping pace with hardware technology conversion is a parallel strategy for applying Martin Marietta's simulation systems expertise to radically improve arcade game play, which will have a direct application in high fidelity war games. To expedite this move to more realistic and challenging games, Sega has adapted Martin Marietta's TARGET database generation system as an integral part of its gameware development environment. This in turn means that further evolutionary development will continue using funds from the commercial sector, with technology applications to military simulations.

Objectives of Compu-Scene development include accurate terrain surface for low level operations; high fidelity, densely packed features that match real-world geodetic positions; full color phototexture with precise, real-world placement; real time processing that simplifies and speeds gaming area construction; unconstrained movement through the gaming area; mission support functions that include laser ranging and precise collision detection; and comprehensive display support, including dome distortion correction and calligraphics.

Product Line. Compu-Scene systems range from the small desktide SE1000 through the medium range Compu-Scene PT2000 to the high performance Compu-Scene VI. Each product comes with full depth buffering with sub-pixel anti-aliasing, full color texture , area of interest scene management, and environment feedback. They also provide correlation of out-of-the-window imagery, infrared and radar imagery for high fidelity weapon system simulation.

Current Status of the Product. All items in the product line are currently in production and are commercially available.

Platform Requirements. TARGET uses commercial UNIX-based workstation platforms (e.g., Sun SPARX™ workstation). Contact Martin Marietta for specific requirements and configuration needs.

Product Schedule. Product is in production; for price and delivery schedule, please contact the manufacturer.

Appendix B.7

FAMSIM

Purpose. STRICOM's Program Manager for the Family of Simulations (FAMSIM) is responsible for all combined arms simulations and computer simulations under the Family of Simulation umbrella. FAMSIM systems support command and control training from platoon through theater level.

Approach. Included in FAMSIM are the Corps Battle Simulation (CBS), Brigade/Battalion Battle Simulation (BBS) and Combat Service Support Training Simulation System (CSSTSS). These simulations provide man-in-the-loop command and control training for commanders and their staffs in a realistic stress filled environment. An additional simulation, JANUS, provides the opportunity for company/team leaders to exercise fighting skills of their platoon leaders in a computer driven environment. Another major STRICOM effort is the Warfighters' Simulation (WARSIM) 2000. This will be the Army's next generation battle simulation. It will utilize state-of-the-art software design and architecture, provide functionality scaleable to the training audience, reduce training overhead, and be capable of interface with virtual and live simulations. Tactical Simulation (TACSIM) is another FAMSIM program that provides an interactive computer-based simulation designed to support the intelligence training. The primary objective of the TACSIM project is to ensure the existence of a common intelligence sensor simulation for (1) stimulating all Army systems requiring raw data from US reconnaissance assets, (2) training intelligence staffs and analysts from division through theater levels with realistic sensor output, and (3) supporting DOD special studies/projects.

The PM of FAMSIM also serves as the DOD Executive Agent for Aggregate Level Simulation Protocol (ALSP) development efforts. ALSP provides a protocol-based initiative for constructive simulations which model units at the "aggregate" level. ALSP provides a mechanism for operation

of Army, Air Force, Navy, Marine Corps and Joint models on a common battlefield. The products of the FAMSIM efforts will be the following simulations:

- Brigade/Battalion Battle Simulation (BBS)
- Combat Service Support Training Simulation System (CSSTSS)
- Corps Battle Simulation (CBS)
- Tactical Simulation (TACSIM)
- Warfighters' Simulation (WARSIM) 2000

Current Status of the Product. Funded and budgeted.

Platform Requirements. TBD.

Product Schedule. The development and production schedule for some of the FAMSIM projects is given in Table B-3.

Table B-3. The STRICOM/FAMSIM Schedule

PROGRAM	FY95		FY96		FY97		FY98		FY99	
	Devel	Prod	Devel	Prod	Devel	Prod	Devel	Prod	Devel	Prod
BBS		X								
CBS										
CSSTSS		X		X						
WARSIM 2000	X		X		X		X			X

Appendix B.8

FLAMES™

Purpose. The Ternion Corporation's FLAMES™ program will provide a modeling and simulation configuration that will support representations of military systems and human behaviors in an interactive environment. FLAMES is a software system; in fact, it is actually a family of integrated and interdependent computer programs configured to provide maximum flexibility and portability. It consists of four main elements, which are the FLAMES Operational Requirements Graphical Editor (FORGE), the FLAMES Scenario Highlighter (FLASH), the FLAMES Interactive Runtime Executable (FIRE), and the FLAMES Analysis and Reduction Environment (FLARE), in addition to the FLAMES database.

Approach. The FLAMES evolutionary approach continues to follow these tenets: (1) develop a modeling system kernel which will act as an extended operating system which will provide a framework for model integration, (2) develop model structures (and models) which can represent all system-specific functionality, and (3) design FLAMES with software maintainability foremost in mind.

The primary results of this effort were twofold, namely: (1) a fully functional FLAMES system, and (2) documentation which will support object oriented development and system maintenance.

FLAMES separates the application-independent kernel from application-dependent Models. The kernel provides many advanced features for all models, and provides a standard framework for model integration. It also greatly enhances software maintainability and reuse. Almost any type of virtual or live simulator can be connected to FLAMES; these simulators have direct access to models executing with FLAMES, and any mix of human-controlled and automated participants can be supported.

Related Projects and Activities. There are a number of programs currently in various stages of completion which are focusing on development of generic interactive simulations. For example, the US Army's Training and Doctrine Command (TRADOC) Scenario Toolkit and Generation Environment (STAGE™) program has a similar intention, albeit more focused on the Computer-Human Interface (CHI) and a glass interface to the hardware/software.

Platform Requirements. The Ternion Corporation has developed FLAMES as a software package which can run on several platforms. As a rule they do not sell bundled hardware/software packages; rather, they focus primarily on their software system. FLAMES has been available for over three years on the Silicon Graphics®/UNIX® system, and just recently (March 1994) it was released for the PC/486 (running Windows/NT™) line of machines. It has been ported to the Sun/UNIX systems and also to the Macintosh®. A test installation on an eight processor Cray® successfully demonstrated its extensibility to supercomputers. Delivery times for a Silicon Graphics/UNIX system, or a PC/486 system, is approximately a one day turnaround (plus shipping time); about 60 days is needed for other platforms.

Current Status of the Program. FLAMES has been a stable system for over three years (the first version was released in the Fall of 1991). It has been demonstrated to, among others, Marine Corps Modeling and Simulation Management Office (MCMSMO) at Quantico, Virginia. FLAMES has already been sold abroad to several foreign governments. Ternion Corporation is helping develop specific models for the Air Force at present. FLAMES is currently licensed in the United States (USAF and US Army), United Kingdom, NATO, and the Republic of Korea.

Project Schedule. FLAMES is a fully developed software system currently available for several platforms. Evolutionary enhancements to the software are likely to provide improvements, not revolutionary changes.

Appendix B.9

GT200™

Purpose. Characteristically, networked simulation systems require high fidelity scene realism while supporting many moving participants and dynamic environmental control. The hardware and software developed by Loral and identified as GT200™ was designed to provide high quality, low cost, real-time image generation for networked simulations. Typical applications of the GT200 include simulation systems for armored vehicles and aircraft platforms. This flexible, multi-channel graphics system will support many more applications besides these for virtual reality visualization needs.

Approach. While the architecture of the GT200 incorporates advanced technology and image generation algorithms, the GT200 is an evolutionary development of Loral's GT100 image generator. The GT200 consists of four circuit boards, which are (1) the CIG Interface Processor, (2) the Database & Polygon Processor, (3) the Texture Tiling Pixel Processor, and (4) the Video Generator/2-D Processor. The GT200 uses a combination of general-purpose embedded processors and special bus structures between polygon and pixel processors to distribute the image processing without the contention that occurs in parallel image generation systems. This bus structure provides a significant benefit in that it eliminates bottlenecks in image processing. Up to ten subsystems are combined to form a GT200 image generation system. The modular design of the GT200 system permits custom configurations, ensures future expansion, and provides the means to incorporate future technology easily and affordably.

One GT200 subsystem supports up to 1,024 moving objects; one to twelve viewing channels; refresh rates up to 60 Hertz (Hz); display resolution up to 1,024 lines; and field of view from 0.5° to 75° per channel. The image processing rate is 480,000 polygons per second per graphics subsystem. The out-of-window view is fully correlated with sensor images.

As noted, the GT200 can support up to 12 independent display channels of imagery per chassis. Each channel may be an independent eyepoint located within a simulated vehicle, or it can be separate. Each display channel's field of view can range in the vertical and horizontal direction from 0.5 to 75 degrees.

The GT200 supports an Application Programmers Interface (API) called the CIG Logical Interface Package (CLIP). CLIP is a software package that provides a logical interface from the host to the image generator (IG). This allows the applications engineers to develop interfaces without needing to know the specifics of the IG system or the protocols used to accomplish this interaction.

The GT200 supports the management of databases in many respects. One or more databases are stored on the hard disk and can be accessed by the simulation host computer via a CLIP interface call. Database downloading is supported for the addition, revision, or update of databases. During real-time operation, database information is loaded as needed from the hard disk to on-line memory. This process is continued as the channel eyepoint moves across the database. Dynamic objects in the scene are passed to the channel graphics processors as they fall within the field of view. The GT200 supports real-time scene management for the altering and viewing and database parameters such as viewing range, level of detail ranges, and object density. The level of detail (LOD) control is supported for all objects within the database with no practical limit in the number of levels.

The GT200 supports the management of at least 1,024 moving model instances within the viewing range. It is capable of real-time updates of at least 2000 moving model instances per second with an average of 3 components per model. There is no limit to the number of moving model instances viewable per channel other than the polygon processing limitations for a given configuration.

Related Products and Activities. A suite of Loral developed database modeling tools called S1000™ supports the GT200. The modeling tools generate a synthetic environment by synthesizing data from various sources (e.g., DMA DTED files). There are several other on-going efforts to also develop graphical environmental generators similar to the GT200 which should also be considered.

Current Status of the Product. Both the GT200 image generator and the S1000 modeling suite are in production. Contact Loral for current configuration options and delivered prices.

Platform Requirements. The GT200 sub-system can be integrated with a number of commercial workstation platforms. The S1000 modeling tools are supported on both the HP/Apollo™ and Silicon Graphics® workstations.

Product Schedule. Products are currently in production. Contact Loral ADS for a delivery schedule.

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Appendix B.10

ITEM

Purpose. The Integrated Theater Engagement Model (ITEM) is an interactive computer simulation providing fully integrated air, land, and naval warfare engagement modules for the analysis of joint-force operations in the theater level campaigns. It is intended for courses of action assessments, force mix assessments, force effectiveness analyses, and for resource planning.

Approach. ITEM is a hybrid Monte Carlo simulation and expected value model intended for single engagements through theater level campaigns. It includes as variables air bases, aircraft and weapons, early warning/ground controlled intercept (EW/GCI) sites, airborne warning and control system (AWACS) stations, combat air patrol (CAP) stations, surface to air missile (SAM) sites and SAMs, ships, aircraft, weapons, battle groups, submarine patrol areas, maritime patrol area (MPA) patrol areas, minefields, forces (Divisions), units (Brigades /Battalions), components (tanks, APCs, personnel, etc.), and target components (conventional attack). The scope of conflict includes both Conventional and Nuclear warfare.

Mission Areas include Sea Control, anti-air warfare (AAW), anti-surface warfare (ASUW), anti-submarine warfare (ASW), Strike, Counter Air (offensive), Counter Air (defensive), Battle Field Interdiction, Close Air Support, Ground Combat Direct and Indirect Fire

Related Projects and Activities. Originally built for United States Pacific Command (USPACOM) by the Defense Nuclear Agency (DNA), the model is now employed by a number of users, including the Office of the Secretary of Defense (OSD), the Joint Staff, the Departments of the Army, Navy, and Air Force, and the Commander-in-Chiefs (CINCs).

Current users include the following: OPNAV (NA-12/OP-81), Naval War College, USCINCPAC, USCINCPACFLT, USPACAF, Joint Warfare Center, US Central Command, US STRATCOM, SACLANT, SHAPE Technical Center, Australian Navy, and the US Naval Postgraduate School.

Platform Requirements. IBM 386/486 (DOS); SUN SPARC stations; readily ported to other UNIX machines (HP, DEC, SG). The software is written in C++.

Current Status of the Project. Currently no Marine Corps funds are being expended on the model. However, for model improvement and maintenance, there will probably be a user fee levied. The Navy (NOSC) continues to spend funds to add modules to the model (e.g., mine-countermining, and air campaign).

Project Schedule. TBD.

Appendix B.11

MARS

Purpose. The purpose of the Multi-Warfare Assessment and Research System (MARS) simulation system is to provide a user-friendly, battle-force level, Monte Carlo model of naval multi-warfare battle engagements of Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Strike Warfare (STW), Mine Warfare (MIW), and Electronic Warfare (EW). The simulation is used to evaluate the effects of new or existing platforms, weapons, or system capabilities, as well as command and control concepts, in the context of multiple platform engagement level analysis. The model is capable of simulating naval engagement situations ranging from battle force level to low intensity conflict. This includes CVBF (sea control, power projection and land strike attack of enemy territory), Surface Action Group (SAG), Underway Replenishment Group (URG), and Convoy and Amphibious Landing operations. The simulation uses generic algorithms to model or calculate system performance based on user defined characteristics and will provide similar fidelity to both offensive and defensive forces, allowing analysis of forces employed in either role. To achieve this goal, MARS provides a user-friendly Graphical User Interface (GUI), allowing for ease of setup, ease of data base and scenario design, and allows the reduction of learning time to use the model.

Approach. The model is being developed at the Naval Surface Warfare Center (NSWC), White Oaks. SPAWAR will use the model for its analysts; NSWC at Dahlgren and Panama City will also be using the model. A mine-countermeasure and an amphibious portion of this model is also to be built. The object-oriented data structure is being adopted for the Naval Simulation System (NSS). The simulation is an event-driven naval warfare simulation in a multi-warfare, multi-mission environment. The MARS simulation provides the battle simulation functions in either a non-interactive mode or a man-in-the-loop (wargaming) mode. In the non-interactive mode, the

simulation provides a single or multiple iteration capability as well as a graphical display during simulation. In this mode, MARS provides a Monte Carlo simulation using a user input decision tree. This mode will generate statistics as output for conducting studies. In the man-in-the-loop wargaming mode, human decisions are employed to try different tactics, as well as to develop operational strategy. In both modes, the simulation functions includes platform kinematics, sensor detections, single and multiple platform data fusion, targeting, weapons assignment, resource allocation, cooperative engagement, launching of platforms, weapons and decoys, engagement outcome and battle damage assessment, and command and control, and communications. The simulation functions also include an interactive graphics display of the battle and selected measures of effectiveness. MARS uses Object-Oriented Analysis and Design (OOA&D) methodology for model structure and uses Object-Oriented Programming (OOP) to implement this design structure. This will allow the implementation of different levels of fidelity in the objects. Additionally, the user-friendly interface allows users to configure many different system architectures, through the use of icons, to allow the model to easily conduct trade-off studies.

MARS applies state-of-the-art technology for simulation to address some of the major shortcomings of existing simulation models. The objectives of MARS include:

- Create an environment which can be adopted or reconfigured easily to study different types of questions, considering that no single model can address every problem in question. To achieve this flexibility, an Object-Oriented approach is taken to build an object library.
- Use an OOP language to ease software modification and enhancement while minimizing the testing time. The use of CASE tools to capture the model design will reduce the required time for updating documentation and model enhancement.

- Ease of use and reduced learning time through the use of a user-friendly GUI and expert system.
- Provide fast turnaround time using discrete event simulation and network computing.

Related Projects and Activities. TBD.

Platform Requirements. MARS can be used on many workstations, such as the SUN, VAXStation, DECStation, Silicon Graphics, HP, IBM PC, and Macintosh II. It requires approximately 100 MB with 16 MB RAM. It is written in MODSIM and CLIPS.

Current Status of the Project. MARS is operational, but continues to evolve.

Project Schedule. TBD.

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Appendix B.12

NSS

Purpose. The Naval Simulation System (NSS) program will develop a set of models functioning within a single framework. It will have an open architecture, and an object-oriented design. The NSS end state will be a family of models functioning within a single framework. It will have the capability to build any variant of simulation at any site, and will incorporate various levels of fidelity.

Approach. This will be the Navy/DON prototype for the JSIMS architecture. It will be shared across Navy Warfare Centers and Navy contractors, and it will exist as a segment of JMCIS. It provides a common warfighting user interface, TAC-X common operating environment, common data sources and object library, and will support analysis terminals.

Related Projects and Activities. JMCIS and COMPASS will provide software and implementation strategies and concepts for use in NSS. NSS will share common data sources and intelligence databases. NSS will evolve over the next three years, as shown in the schedule in Table B-4 below.

Platform Requirements. TBD.

Current Status of the Project. TBD.

Project Schedule. Near-term schedule for NSS is shown in Table B-4 below.

Table B-4. Naval Simulation System Evolution

FY95	FY96	FY97
Complete NSS Ver 1.0 Transition CWM to MARS Taxonomy Adapt CWM Simulation Engine to MARS Taxonomy Increment 1 Object Build Transition MARS-Mine Objects into NSS Object Build	Release NSS v1.0 Complete NSS Ver 2.0 Define, Design Object Library & Tools Increment 2 Object Build Define/Design Object Library & Tools	Release NSS v2.0 Complete NSS Ver 3.0 Ensure JSIMS Architecture Compliant Increment 3 Object Build Define/Design Object Library Extensions
Define/Design Phase II Simulation Core	Design/Implement Phase II Simulation Core	
Harvest SEWSIM Requirements into OOA Framework.	Design/Implement SEWSIM Objects into NSS	

Appendix B.13

RASPUTIN

Purpose. Rapid Scenario Preparation Unit for Intelligence (RASPUTIN) is an automated, knowledge-engineered, rule-based scripting tool that allows the user to build a detailed scenario with minimal input. It uses expert system software to compose, deploy and move military forces from major units down to vehicle in a doctrinally accurate manner. It is, at the same time, a map-based visual scenario generation tool. It generates a Geographic Information System (GIS), an Expert System (ES), and a vast Relational Database to produce realistic and accurate deployments of involved forces from Corps level to individual vehicles. Global terrain data, detailed weather, and exhaustive equipment parametrics are coupled with doctrinal deployment knowledge to give scenario developers the power to lay down and move forces easily, accurately, and in great detail.

Generally speaking, a war game starts long before the first shots are fired. RASPUTIN supports pre-hostility play, realistically deploying and advancing units into desired postures to feed intelligence collection simulators. Perceived ground truth can then be the basis for early battlefield decisions.

Approach. RASPUTIN is intended to generate detailed, doctrinally correct military deployment scenarios for collection simulators. Its software includes databases of military organizations and equipment for Blue, Orange, and Gray forces, geographic products, weather, and fixed sites. Its capabilities include the following:

- Scenario scripting from Corps down to the vehicle level
- Automated intelligent deployment of ground, Naval and Air Forces

- Databases will include global geographic coverage, global weather data for an entire year, and a global fixed site database.
- Supports Blue and Orange TO&E
- Provides a rule-based system which contains Blue and Orange doctrine
- Provides an intuitive graphical user interface

RASPUTIN is designed to be used directly by the analyst with basic computer skills (operate a mouse and a Windows-type environment). The user does not need extensive knowledge of military forces or deployments.

Related Projects and Activities. RASPUTIN interfaces with Tactical Simulation (TACSIM), CBS, Combat Service Support Training Simulation System (CSSTSS), and Joint-Modeling and Simulation System (J-MASS). It is similar to FLAMES™ and other combined analysis or training systems.

Platform Requirements. RASPUTIN hardware is based on Sun Sparc 64 megabyte systems. Specific hardware architecture depends on the size of the scenarios to be generated, and the user's operational needs. For regional scenario generation (e.g., for Europe) the equipment needed is shown in Table B-5.

Table B-5. Equipment Requirements for RASPUTIN

EQUIPMENT	QUANTITY
Sun Sparc 4c (Sparc 2) 64 MB Systems	1 or more
2-Gigabyte Hard Drives	3
8 mm Exabyte Tape Drive with Compression	1
NCD 19" color X-Terminal (optional)	1
Uninterruptable Power Source (UPS) (recommended)	1

RASPUTIN uses the following COTS software: SOLARIS 1.1.1 (Sun OS 4.1.3) operating system; X11R5; Motif 1.2; SYBASE database management system; GENAMAP geographic information system; and PROKAPPA expert system. The system contains approximately 150,000 lines of code, all written in C.

Current Status Of The Project. The system reached initial operating capability in March 1992; version 2.0 was released in May 1994 and has been deployed to US Army installations around the world.

Project Schedule. Release of RASPUTIN is expected shortly; releases will be handled through the Operations Support Office, US Army. Points of contact there is either CAPT Alan Hendricks (202-279-2145) or Ms. Lisa Valero (202-279-2398). The Open Fax number is (202) 279-2134.

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Appendix B.14

SEE

Purpose. The Synthetic Exercise Environment (SEE) is a DIS-compatible database for a fictional world; SEE was developed by the Defense Nuclear Agency (DNA). The objectives of the SEE program are as follows:

- Create a digital geographic database of an artificial world, with supporting cartographic information and installation data, to support computer-based planning modeling, simulations, and exercises
- Develop a climatological and meteorological database with the tools required to introduce weather into simulations and exercises
- Provide tools for exercise planners to use with the SEE database products in planning, setting up, and evaluating exercises

Given the fundamental changes that have taken place in the world order over the past few years and that continue to occur, simulation, wargaming, and exercises are playing an increasingly important role in the development and planning of new operational concepts for US and allied forces and in the assessment of their likely effectiveness. Great emphasis has been placed on the development of advanced, automated gaming, planning, and analysis tools that can provide a highly realistic, real-time environment for these activities, and Distributed Interactive Simulation (DIS) already provides a means to link live systems and wargaming centers on a worldwide basis to create a virtual battlefield. One major concern to the simulation community is the requirement to establish standards for database design and to develop correlated synthetic worlds that ensure compatibility among the

widespread family of users. Another is the need for a means to conduct wargames in an apolitical but operationally realistic environment that avoids the traditional East/West characterizations. DNA's SEE program combines leading-edge software technology with a practical, user-oriented display system to optimize the gaming, training, and analysis experience. In addition, SEE data will support perspective and fly-through views in distributed interactive simulations.

Approach. The SEE software development process embodies state-of-the-art concepts, techniques, and methodologies. Its architecture and toolkit are built on industry standards, such as UNIX, MOTIF, and X-Windows. The SEE database of geographic, climatic and meteorological information interfaces with models and simulations through an internal template. A model of an artificial world created by SEE appears as another product from DMA. The database includes tools to introduce weather during the simulation. It also includes tools for pre-exercise planning and post-exercise analysis. SEE uses the Vector Products Format (VPF), the new DMA standard, to construct geographic features and building topology. SEE map products will meet all DMA standards while adhering to evolving DIS standards. In this manner exercise participants located on synthetic continents will be provided realistic DTED to obtain appropriate perspective views.

Related Products and Activities. When fully developed, the SEE Forces Master Database will consist of generic fixed installations, generic enemy order of battle (OOB), actual friendly forces OOB and realistic weapon systems attributes. Development plans include packages for the whole spectrum of regional conflicts; low intensity conflict with irregular forces through nuclear exchange between major powers.

SEE will also provide synthetic continents to other models. For example, assume Marine Forces Atlantic (MARFORLANT) desires a staff training exercise on MAGTF Tactical Warfare Simulation (MTWS). Exercise planners use SEE to create a synthetic continent called Atlantis; all manner of scenarios are now available for consideration without concern for political sensitivities.

Platform Requirements. SEE uses standard operating systems (e.g., UNIX, MOTIF). Hardware requirements are HP 700™ Series or Sun SPARX2™ (or better) workstations.

Current Status of the Product. Interim delivery of the first geographic product (no toolkit) is planned for April 1995. An IOC is planned for November 1995, with the delivery of additional geographic products and a toolkit. October 1996 is the release date for the debugged version of SEE. The development contract terminates in September 1997.

Product Schedule. Once development is completed, SEE will be transferred to a Joint agency (e.g., J-7, JWC) for distribution control.

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Appendix B.15

STAGE™

Purpose. STAGE™ is a workstation software system for designing synthetic environments without programming, that can be used for tactics training, operational analysis, or for mission equipment stimulation. It is a multi-purpose toolkit that lets one rapidly develop distributed simulations. STAGE provides many benefits: (1) simulation framework to easily integrate models and simulators in a common tactical environment, (2) DIS support, (3) intuitive interface for scenario preparation and execution control, and (4) real-time generation of complex, interactive and high track load synthetic environments.

STAGE was designed for use in training and simulation applications, operational tactics evaluation applications, and in the stimulation of Human-Machine Interfaces (HMIs) for test and validation. STAGE is a multi-purpose software package that can be adapted to any environment. STAGE can be used in any training application where a realistic outside world environment is required. STAGE provides the benefits of an operator reconfigurable scenario generator with the flexibility of a building block, modular simulation architecture that can be modified and enhanced with the addition of custom-developed simulation models. It is portable across any UNIX® platform and makes maximum use of a distributed processing or multi-processor environment.

Approach. Users can rapidly prototype a functional simulator with STAGE objects and then integrate additional high fidelity simulation models. STAGE lets users rapidly prototype a simulator then increase the fidelity and capability until a final product is achieved. The rapid prototyping process allows for an early demonstration of a system's functionality. A user simply modifies a pre-set list of parameters and curves using a point and click window interface to create new systems. No programming is required. Objects can be defined, refined, and combined to create scenarios.

Aircraft, ships, submarines, and armored forces can be created and linked together in a scenario with maneuvers and tactics. The scenario can be executed in real time or non-real time. Objects can be controlled on-line and various control paradigms can be substituted to provide semi-automated forces.

Objects can also be given specific functionality to create intelligent targets. The intelligence is described in STAGE's script language -- an English-like format that can be created without programming by a subject matter expert. STAGE can be used to create realistic synthetic environments to stimulate prototype displays for validation and test purposes.

Related Projects and Activities. It is understood that USAF and Navy (PME-1) have used STAGE models, and also the Theater Area Command & Control Simulation Facility (TACCSF). NRaD is also using STAGE models.

Platform Requirements. STAGE is a software suite that is adaptable to many UNIX-based hardware configurations.

Current Status of the Project. STAGE was developed by Virtual Prototypes and so far have invested about 37 man-years of effort to perfect this capability. They currently have seven engineers dedicated to STAGE maintenance and evolutionary growth. Virtual Prototypes continues to provide support to STAGE and also fund their own refinements to it.

Project Schedule. There are no major updates planned for the immediate future for STAGE. It is a mature, stable software package.

Appendix B.16

VAST

Purpose. Vulnerability Analysis for Surface Targets (VAST) is a component-level point burst methodology that is used to estimate the vulnerability of a surface target to a hit either by a shaped charge jet or by fragmentation from artillery. VAST is an expected value model that infers the vulnerability of a target from the cumulative effects of calculated component damage, which degrades the tactical functions of such an inflicted ground armored vehicle.

Approach. VAST models damage mechanisms of penetration and spall on components. It does not model the effect of other damage mechanisms, such as ricochet, secondary spall formation or hydraulic ram.

VAST requires a variety of input data that includes a table defining each component of the surface target, a table of component conditional probabilities of kill, data describing an attacking munition, a rule book for converting component loss into tactical degradations of vehicular functions, and files containing geometric information on the armored vehicle.

For fragments from an artillery shell, VAST produces tables of vulnerable areas for individual components and for the target. For a shaped charge jet, VAST produces target probability of kill estimates.

Related Products and Activities. TBD.

Platform Requirements. VAST currently runs on a CRAY XM-P under a UNICOS operating system. It requires 300K words of memory for program execution; memory requirement for a typical geometry file is 5,000K words. VAST is written in Fortran.

Current Status of the Product. TBD.

Product Schedule. TBD.

Appendix B.17

VIT

Purpose. The Virtual Interactive Target (VIT) program is designed to advance the representation of weapons effects and target responses at the virtual and constructive levels of modeling and simulation. The VIT provides an electronic battleground for attack forces in DIS wargaming. Most current weapon effects models do not produce real-time data or facilitate visualization of weapon effects and target damage. This is because the volume of output data and non-standardized output formats from most physics models would confound and overload an interactive simulation network. The VIT program bridges this obstacle using streamlined weapon effect codes that produce real-time representations of target damage. These credible damage representations can then be confidently incorporated into real-time simulations for training and analyses.

VIT is a hardware/software system developed by the Defense Nuclear Agency (DNA) to provide DIS-compatible interactive targets for simulations. Communicating through Protocol Data Units (PDUs), the VIT assesses weapon effects and target responses and visually displays them in real-time to the user. The VIT offers credible damage representation to a DIS exercise without overloading the network. As a stand-alone simulator, the VIT can work in analysis mode. Used as a DIS node, VIT gives other players responsive targets. Finally, a VIT integrated into another DIS node can calculate weapon's effects for the node's internal use.

Approach. The VIT is specifically oriented toward the DIS community and incorporates standard and prototype DIS PDUs as part of the communications architecture. VIT is supported by a coherent data management Computer Software Component (CSC) which provides a framework for inclusion of weapon/target phenomenology models and data. The CSC consists of weapon characteristics databases, weapon effects algorithms databases, target functional and physical vulnerabilities databases, and target response algorithms and databases for determining target degradation due to

weapons effects. Standardized internal interfaces facilitate rapid inclusion of new algorithms and data.

While the VIT is physics based, the CSC makes the number crunching transparent to the DIS exercise. In this manner, the VIT also serves as ground truth for battle damage assessment. The VIT models command posts, bunkers, aircraft shelters, runways, buildings, missiles and re-entry vehicles, as well as other targets of military interest. Cratering of runways and earth are also modeled. Anticipated capabilities include increased target complexity, effects of enhanced payloads, release of NBC contaminants and increased battle damage assessment support including infrared signatures.

Related Products and Activities. The VIT is a standalone product, intended for use in any DIS exercise. The VIT product is related to other DNA activities concerning weapon effects and target responses, battle damage assessment and nuclear, biological or chemical (NBC) hazard prediction.

Platform Requirements. The VIT is currently hosted on two networked Silicon Graphics® high performance graphics workstations. The Visualization Engine is hosted on an Onyx Re²™ machine, while the Physics Engine is hosted on an Indigo² Extreme™.

Current Status of the Product. The VIT is DIS-certified; the current version is available immediately. VIT is fully developed and operational.

Product Schedule. Contact the Defense Nuclear Agency for delivery information and future updates to the VIT software.

Appendix C

Marine Corps M&S Functional Capabilities

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Appendix C.1

Introduction

This appendix contains a set of tables that were developed to indicate the relevance of identified M&S functional capabilities in supporting each of the Marine Corps' desired eight M&S end states. Eight M&S capability classes were identified that are considered essential if the Marine Corps is to attain its stated end states. These eight capability classes are:

(1) realistic behavioral representations, (2) realistic physical representations of systems; (3) realistic physical environmental representations, (4) a scenario generator, (5) a simulation engine, (6) simulators, (7) instrumented systems, and (8) constructive models. Principle M&S functional capabilities were then identified for each of the capability classes and an importance or relevance weight assigned for each functional capability relative to each end state. A one (1) indicates the functional capability is useful in attaining an end state; a two (2) indicates it is important to attaining an end state, and a three (3) indicates it is essential if an end state is to be attained. The weights were determined by a group of Marine Corps M&S users that represented the M&S functional areas of education and training, military operations, analysis, research and development, and logistics. The tables containing these weights are provided in the following subsection.

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Appendix C.2

Relevance of M&S Functional Capabilities to End States

Table C-1 provides the weight for each functional capability identified under realistic behavioral representations.

Table C-1. M&S Capability Class: Realistic Behavioral Representations

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
								Provide Realistic Computer Generated Forces that conform with doctrine, tactics, techniques and procedures for
3	1	3	3	3	3	1	3	MAGTF Command and Control
								Opposing Forces
3	1	3	3	3	1	3	3	Command and control
3	1	3	3	3	1	3	3	Tactical units
2	1	3	2	1	1	2	2	Individual combatants
								MAGTF organization across the element (CE, GCE, ACE, CSSE, Naval Element)
3	1	3	3	2	1	3	3	Tactical units
3	1	3	3	2	1	3	3	Organizational units
3	1	3	3	2	1	1	3	MEF
2	1	3	2	2	1	2	2	Individual combatant
2	1	3	2	2	1	2	2	Small unit
2	1	2	3	2	1	1	3	Maritime Prepositioned Ships (MPS)
3	1	3	3	2	1	2	2	Non-combatants
3	1	2	1	1	1	1	1	Component Headquarters
3	1	2	1	1	1	1	1	Joint Task Force Headquarters
2	1	2	1	1	1	1	1	Supporting Establishment
3	1	2	1	1	1	1	1	Other Services/Allied Forces

As indicated in the table, command and control is considered important both in MAGTF and opposing forces representations of computer generated forces. Development of a joint

simulation system promises to provide many of the realistic behavioral representations indicated in Table C-1. Exceptions to this may be those cases related to MAGTF command and control, the MAGTF organization, and Maritime Prepositioned Ships (MPS). These may or may not be developed under the joint simulation system project, depending on the final decision of the exact definition of Service unique. Portions of MAGTF command and control and MAGTF organizational behaviors are being developed by ARPA as part of the LeatherNet Project and to support Marine Corps participation in STOW '97. The Marine Corps may be able to leverage ARPA efforts in support of the STOW demonstration to extend the set of behaviors currently being developed. A DMSO funded joint project that the Marine Corps is actively participating in promises to provide behavioral models at the individual combatant level for both Marines and opposing forces, and the ability to aggregate them into small unit behaviors.

Table C-2 provides the weights for functional capabilities within the realistic physical representations of systems class. Providing realistic physical models of both Marine Corps and threat weapons systems and equipment platforms are considered equally important. These are followed closely by realistic physical models of other Service's and coalition forces weapon systems and equipment platforms. The joint simulation system should provide all the physical representations required for threat, other Service's and coalition systems and equipment. It should also provide representations for a major part, if not all of the Marine Corps systems and equipment platforms. The final definition of Service-unique will determine which if any representations of Marine systems and equipment will have to be developed by the Marine Corps.

Table C-2. M&S Capability Class: Realistic Physical Representations of Systems

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
3	3	3	3	3	1	3	3	Provide realistic physical models of Marine Corps weapons systems and equipment platforms
3	3	3	3	3	1	3	3	Provide realistic physical models of threat weapons systems and equipment platforms
3	2	3	3	3	1	1	3	Provide realistic physical models of other Service's weapons systems and equipment platforms
2	2	3	2	1	1	1	3	Provide realistic physical models of coalition forces weapons systems and equipment platforms

Table C-3 provides the weights for the functional capabilities that support realistic physical environmental representations. Compatible terrain databases at all levels of resolution, portrayal of meteorological effects, and the capability to interact with the environment are considered the most important in this capability class.

Table C-3. M&S Capability Class: Realistic Physical Environmental Representations

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
3	3	3	3	3	1	3	3	Compatible terrain data bases at all levels of resolution
3	1	3	3	3	1	3	3	Provide capability to interact with the environment (immersion)
3	2	3	3	3	1	2	3	Portray meteorological effects
2	2	2	2	3	1	2	3	Portray other physical environmental effects
2	1	2	2	2	1	2	3	Portray combat effects
2	2	3	1	1	1	1	1	Provide rapid generation of terrain representations (48 hours)
2	3	3	1	1	1	1	2	Provide capability to move through the environment (Magic Carpet)

Extensive efforts within the joint community, sponsored by DMSO and ARPA, should be able to address most if not all of the Marine Corps needs, particularly since the Marine Corps is an active participant in most of these. Those not developed under the current efforts should be available as part of the joint simulation system. The one area of concern is the littoral regions of the world. Little effort is currently underway to model this area. A joint project related to mine and countermining warfare may provide the initial underpinnings for modeling littoral regions. If the Marine Corps is willing to develop the requirements for a littoral data base, the Marine Corps may be able to convince the Oceanographer of the Navy to construct the detailed databases for these regions. It appears that this is the one area that the Marine Corps will have to aggressively champion if it wants to meet its needs.

Table C-4 and Table C-5 address the functional capabilities to support a scenario generator and a simulation engine, respectively. Eventually the joint simulation system will provide both of these, but not within the time frame required by the Marine Corps to support its analytical requirements. These both should be object-oriented (not object-based). Products that meet the Marine Corps requirements are currently commercially available and were discussed in Appendix B. Other government developed applications are also available. Eventually the Marine Corps will move toward the use of a common scenario generator and simulation engine to support all simulations and system needs.

Table C-4. M&S Capability Class: Scenario Generator

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
								Provide readily accessible common databases
3	3	3	3	3	1	3	3	Terrain
3	3	3	3	3	1	3	3	Threat laydown
3	3	3	3	3	1	2	3	Friendly force laydowns
2	2	3	3	1	1	1	3	Political, social and cultural aspects of region
2	3	3	2	2	1	2	2	Provide graphical user interface
2	2	3	1	1	1	1	1	Provide capability for rapid scenario generation

Table C-5. M&S Capability Class: Simulation Engine

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
								Support accreditable interactions between environmental and behavior representations and scenario generator
3	3	3	3	3	1	3	3	Combat Operations
3	3	3	3	3	1	2	3	Operations Other than War
3	3	3	3	3	1	2	3	Logistics
3	3	3	3	3	1	2	3	C4I
3	1	3	3	3	3	3	3	Integrate external stimuli (virtual simulation and live interactions)
3	1	3	3	3	1	3	3	Provide dynamic interaction
3	1	3	1	1	3	3	3	Support stimulation of Marine Corps C4I systems

The importance weights for the functional capabilities that support simulator development are provide in Table C-6. The ability to be integrated into a larger synthetic environment is the most important aspect in developing simulators. Those simulators that support training on weapons systems are considered more important than those that support training for combat service support elements and equipment, and simulators that support training or military operations preparation are considered more important that those that are basically targeted for improving the Combat Development Process (CDP) and Planning, Programming, and Budgeting System (PPBS) processes. The current laser disk-based individual and small unit ground combatant simulators will need to be replaced by 3-dimensional computer generated representations of the environment and threat. Several Marine Corps advanced technology demonstrations are keyed to accomplishing this. The CVAT program if funded will provide an appended training capability for ground weapons systems for the Marine Corps. If not, there are more specific ground weapons system simulators that can be leveraged to meet the Marine Corps requirements in this area. The key to meeting the Marine Corps future simulator requirements is deployability.

Table C-6. M&S Capability Class: Simulators

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
3	1	3	3	3	2	3	3	Support integration into larger synthetic environment
3	1	3	3	3	1	3	3	Support ground weapons systems training
3	1	3	3	3	1	3	3	Support fixed wing aircraft training
3	1	3	3	3	1	3	3	Support rotary wing aircraft training
3	1	3	3	3	1	3	3	Provide manned simulators
2	1	3	3	3	1	3	3	Support individual combatant training
2	1	3	3	3	1	3	3	Support unit training
2	1	2	3	3	1	2	3	Support ground transport systems training
1	1	1	2	3	1	2	3	Provide reconfigurable simulators
3	1	3	1	1	1	3	1	Provide deployable simulators
3	1	3	1	1	1	3	1	Provide embedded simulators
3	1	3	1	1	1	3	1	Provide appended simulators

Table C-7 provides the weights associated with the functional capabilities that support instrumented systems. The importance of instrumented systems and the ability to conduct instrumented live exercises is evident with the emphasis that the Commandant of the Marine Corps is placing on the Marine Corps attaining this capability. Again the most important aspect of instrumented systems is being able to support their integration into a larger synthetic environment.

Table C-7. M&S Capability Class: Instrumented Systems

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
3	1	3	3	3	2	3	3	Support integration into larger synthetic environment
3	1	3	3	3	1	3	3	Provide tracking and aggregation of weapon platforms
3	1	3	3	2	1	3	3	Provide tracking and aggregation of tactical units
3	1	3	3	3	1	2	3	Determine projectile point of impact
2	1	3	3	2	1	1	2	Provide tracking and aggregation of individual ground combatants

Table C-8 addresses constructive models. The ability to provide accreditable algorithms is considered the most important aspect of constructive models, followed by the ability to provide engagement adjudication models at all levels from one-on-one through theater level engagements. The best of the legacy models need to be identified to support Marine Corps analysis and planning requirements. New model development should be limited to use of the object-oriented paradigm that will promote modular programming and object reuse.

Table C-8. M&S Capability Class: Constructive Models

Supported End State								M&S Functional Capabilities
1	2	3	4	5	6	7	8	
3	3	3	3	3	1	3	3	Provide accreditable algorithms
3	2	3	3	3	1	3	3	Provide engagement adjudication models (one-on-one through theater)
1	1	1	3	3	1	3	3	Provide models of physical phenomenon
1	1	1	3	3	1	3	3	Provide engineering level models
1	2	1	3	3	1	1	3	Provide models of non-combat processes (e.g., manpower)

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GLOSSARY

AAAV	Advanced Assault Amphibious Vehicle
AAW	Anti-Air Warfare
ACAT	Acquisition Category
ACE	Air Combat Element
ADCATT	Air Defense Combined Arms Tactical Trainer
ADS	Advanced Distributed Simulations
ADSS	Advanced Display and Debriefing Subsystem
A-FIST	Armor Full-Crew Interactive Simulator Trainer
AFMSS	Air Force Mission Support System
AOR	Area of Responsibility
APT	Aircrew Procedures Trainer
ARI	Army Research Institute
ARL	Argonne National Laboratory
ARPA	Advanced Research Projects Agency
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATD	Advanced Technology Demonstration
AVCATT	Aviation Combined Arms Tactical Trainer
AW	Amphibious Warfare Technology Directorate
BAA	Broad Agency Announcement
BBS	Brigade/Battalion Battle Simulation
BDS-D	Battlefield Distributed Simulation-Demonstration
BFTT	Battle Force Tactical Training
BLRSI	Battle Lab Reconfigurable Simulator Initiative
CAS	Close Air Support
CASE	Computer Aided Software Engineering
CATT	Combined Arms Tactical Trainer
CAX	Computer Assisted Exercise
CBS	Corps Battle Simulation
CCAX	Computer-Assisted Combined Arms Exercise
CCF	Command and Control Facility
CCH	Computer Controlled Hostiles
CCTT	Close Combat Tactical Trainer
CDP	Combat Development Process
CE	Command Element

CGF	Computer Generated Force
CINC	Commander-in-Chief
CMF	Combat Mission Folder
CMS	Common Mapping Standard
COA	Course of Action
COAP	Course of Action Planner
COC	Combat Operations Center
COMPASS	Common Operational Modeling, Planning And Simulation System
CONUS	Continental United States
COTS	Commercial-Off-The-Shelf
CPU	Central Processing Unit
CSC	Computer Software Component; Computer Sciences Corporation
CSSE	Combat Service Support Element
CSSTSS	Combat Service Support Training Simulation System
CVAT	Combat Vehicle Appended Trainer
C2	Command and Control
C3I	Command, Control, Communications and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
DAFOS	Deployable Advanced Fire Observation Simulator
DBMS	Database Management System
DCSWT	Deployable Crew-Served Weapons Trainer
DCT	Digital Communications Terminal
DEC™	Digital Equipment Corporation
DEEM	Dynamic Environmental Effects Model
DFO/MULE	Deployable Forward Observer/Modular Universal Laser Equipment
DIS	Distributed Interactive Simulation
DMA	Defense Mapping Agency
DMSO	Defense Modeling & Simulation Office
DNA	Defense Nuclear Agency
DOD	Department of Defense
DON	Department of the Navy
DPS	Data Preparation Subsystem
DRPM	Direct Reporting Program Manager
DSE	Dynamic Synthetic Environment
DSI	Defense Simulation Internet
DT	Developmental Test
DTD	Data Transfer Device
DT&E	Developmental Test and Evaluation
DTED	Digital Terrain Elevation Data

DTT	Deployable Turret Trainer
ECP	Engineering Change Proposal
ENCATT	Engineering Combined Arms Tactical Trainer
EO/IR	Electro Optical/Infrared
ES	Expert System
ETMO	Education, Training, and Military Operations
EW	Electronic Warfare
FAC	Forward Air Controller
FAMSIM	Family of Simulations
FDC	Fire Direction Center
FIRE	FLAMES Interactive Runtime Executable
FIST	Full-Crew Interactive Simulator Trainer
FLAMES™	Force Level Analysis & Mission Effectiveness System
FLARE	FLAMES Analysis and Reduction Environment
FLASH	FLAMES Scenario Highlighter
FO	Forward Observer
FOC	Full Operational Capability
FORGE	FLAMES Operational Requirements Graphical Editor
FSCATT	Fire Support Combined Arms Tactical Trainer
FSCC	Fire Support Coordination Center
FY	Fiscal Year
GB	Gigabyte
GCE	Ground Combat Element
GIS	Graphical Information System
GOTS	Government-Off-The-Shelf
GPS	Global Positioning System
GUI	Graphic User Interface
Hz	Hertz
HMD	Helmet Mounted Display
HMI	Human-Machine Interface
HP	Hewlett Packard
ICD	Interface Control Document
ICSS	Individual Combatant Simulation System
IDA	Institute for Defense Analysis
IPR	Interim Program Review
IOC	Initial Operational Capability

ISMT	Indoor Simulated Marksmanship Trainer
IST	Institute for Simulation and Training
ITEM	Integrated Theater Engagement Model
ITEMS	Integrated Tactical Environment Modeling System
J-MASS	Joint-Modeling and Simulation System
JMCIS	Joint Maritime Command Information System
JPO	Joint Program Office
JSIMS	Joint Simulation System
JTF	Joint Task Force
JTCTS	Joint Tactical Combat Training System
JWC	Joint Warfare Center
LAV	Light Armored Vehicle
LAV-FIST	Light Armored Vehicle Full-Crew Interactive Simulator Trainer
LLDR	Lightweight Laser Designator Rangefinder
LWTC	Littoral Warfare Training Complex
MAEWR	Mid-Atlantic Electronic Warfare Range
MAGTF	Marine Air Ground Task Force
MARCORSYSCOM	Marine Corps Systems Command
MARFORLANT	Marine Forces Atlantic
MARS	Multiwarfare Assessment and Research System
MCAGCC	Marine Corps Air Ground Combat Center
MCG&I	Mapping Cartography, Geodesy and Imagery
MCMSIS	Marine Corps Modeling and Simulation Investment Strategy
MCMSMO	Marine Corps Modeling and Simulation Management Office
MCMSMP	Marine Corps Modeling and Simulation Master Plan
MCTFIST	Marine Corps Tank Full-Crew Interactive Simulation Trainer
MDAP	Major Defense Acquisition Program
MDT2	Multi-Service Distributed Training Testbed
MEF	Marine Expeditionary Force
MB	Megabyte
mhz	megahertz
MINT	MAGTF Interoperable Network for Training
MIW	Mine Warfare
MMI	Man Machine Interface
MNS	Mission Needs Statement
MOA	Memorandum of Agreement
MOUT	Military Operations in Urban Terrain

MPM	Mission Planning Module
MPS	Mission Planning Subsystem; Maritime Prepositioned Ships
MS	Milestone
M&S	Modeling and Simulation
MTWS	MAGTF Tactical Warfare Simulation
NAPDD	Non-ACAT Program Definition Document
NATO	North Atlantic Treaty Organization
NAWCTSD	Naval Air Warfare Center Training Systems Division
NBC	Nuclear, Biological, Chemical
NGS	Naval Gunfire Spotters
NRAD	Naval Research and Development Center
NSS	Naval Simulation System
NSWC	Naval Surface Warfare Center
OADS	Office of the Assistant Secretary of Defense
O&M	Operations and Maintenance
OOA&D	Object Oriented Analysis and Design
OOB	Order of Battle
OOP	Object Oriented Programming
ORB	Object Request Broker
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT	Operational Test
OTS	Off-the-Shelf
PC	Personal Computer
PDP	Program Development Plan
PDU	Protocol Data Unit
PIP	Product Improvement Program
PLRS	Position Location Reporting System
PM	Program Manager
POM	Program Objective Memorandum
POP-D	Proof of Principle-Demonstration
PPBS	Planning, Programming and Budgeting System
P3I	Pre-Planned Product Improvement
R&D	Research and Development
RAM	Random Access Memory
RASPUTIN	Rapid Scenario Preparation Unit for Intelligence

RFP	Request for Proposals
RISC	Reduced Instruction Set Computer
RSIM	Reconfigurable Simulators
SAF	Semi-Automated Forces
SAG	Surface Action Group
SAIC	Science Application International Corporation
SAR	Search and Rescue
SEE	Synthetic Exercise Environment
SEWSIM	Space and Electronic Warfare Simulation
SOW	Statement of Work
STAGE	Scenario Toolkit And Generation Environment
STOW	Synthetic Theater of War
STRICOM	Simulation, Training, and Instrumentation Command (US Army)
STW	Strike Warfare
SURE	Small Unit Rehearsal Environment
T&E	Test and Evaluation
TACCSF	Theater Area Command & Control Simulation Facility
TACP	Tactical Air Control Party
TACSIM	Tactical Simulation
TACTS	Tactical Aircrew Combat Training System
TAMPS	Tactical Aircraft Mission Planning System
TARGET	Training And Rehearsal Generation Toolkit
TBD	To Be Determined
TCTS	Tactical Combat Training System
T&E	Test and Evaluation
TEMP	Test and Evaluation Master Plan
TES	Tactical Engagement Simulation
TO&E	Table of Organization & Equipment
TOPSCENE	Tactical Operation Preview Scene
TRADOC	Army Training and Doctrine Command
TSFO	Training Set Fire Observation
TTES	Team Target Engagement Simulator
TWSEAS	Tactical Warfare
UAV	Unmanned Aerial Vehicles
URG	Underway Replenishment Group
US	United States
USA	United States Army

USAF	United States Air Force
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	United States Navy
USPACOM	United States Pacific Command
VAST	Vulnerability Analysis for Surface Targets
VIT	Virtual Interactive Target
VPF	Vector Products Format
VPI	Virtual Prototypes, Inc.
VV&A	Verification, Validation and Accreditation
WARSIM	Warfighters' Simulation
WISS	Weapons Impact Scoring Sets
WST	Weapon Systems Trainer (aviation)
2-D	2-Dimensional
3-D	3-Dimensional